AIR QUALITY ASSESSMENT

RDF Energy No.1 Ltd
Newport ERF

Prepared for:
RDF Energy No.1 Ltd

Date:
February 2023

Project Issue Number:
SOL_22_P087_CO_AQA

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VERSION CONTROL RECORD			
Contract/Proposal Number:		SOL_22_P087_CO_AQA	
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Reviewers Signature:			
Issue	Description of Status	Date	Reviewer Initials
1	First Issue	February 2023	EH

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EXECUTIVE SUMMARY

Sol Environment Ltd has been commissioned by RDF Energy No.1 Ltd to undertake an assessment of the likely local air quality impacts arising from an Energy Recovery Facility (ERF) on land within the port area in Newport, South Wales. The ERF will thermally treat Refuse Derived Fuel (RDF). Emissions to air will be via a 50 m high stack.

Detailed dispersion modelling has been undertaken to determine potential impacts at nearby sensitive human and habitat receptors.

The maximum impact on human health of pollutant emissions from the site is considered not significant on the basis of the Environment Agency criteria and professional judgement.

The impact of emissions from the proposed facility on habitat sites has also been assessed. It was concluded that no likely significant effects are predicted on qualifying features of the European habit sites, and no significant harm is predicted for notified features of the nationally designated Sites of Special Scientific Interest.

1. INTRODUCTION

Sol Environment Ltd has been commissioned by RDF Energy No.1 Ltd to undertake an assessment of the likely local air quality impacts arising from the installation of an Energy Recovery Facility (ERF) on land within the port area, Newport, South Wales. The report supports an Environmental Permit Application for the facility.

The proposed installation site is located in an urban / industrial area, approximately 3.5 km to the south of the city centre. The site location is presented in Figure 1.1. The nearest residential property is a farm approximately 1.0 km to the south. The nearest residential area is approximately 1.2 km to the west in Duffryn. There are numerous sensitive habitat sites within 2 km of the installation including the Severn Estuary and River Usk European habitat sites.

The facility will thermally treat Refuse Derived Fuel (RDF). Emissions to air from the facility will be via a single 50 m stack.

Emissions to air from the facility would be governed by the Industrial Emissions Directive[1] (IED), which requires adherence to emission limits for the following pollutants:

- Total dust (as PM_{10} and $PM_{2.5}$);
- Oxides of nitrogen (NO_x);
- Carbon monoxide (CO);
- Gaseous and vaporous organic substances, expressed as total organic carbon;
- Sulphur dioxide;
- Hydrogen chloride;
- Hydrogen fluoride;
- Twelve trace metals; and
- Dioxins and furans.

The assessment for IED emissions has also considered emissions of ammonia (NH_3), polycyclic aromatic hydrocarbons (PAHs, as benzo(a)pyrene) and polychlorinated biphenyls (PCBs).

This report presents the findings of a dispersion modelling assessment to determine the impact of the installation on air quality at sensitive human and habitat receptors in the surrounding area.

A glossary of common air quality terminology is provided in **Appendix A**.

1 The Industrial Emissions Directive, 2010/75/EU

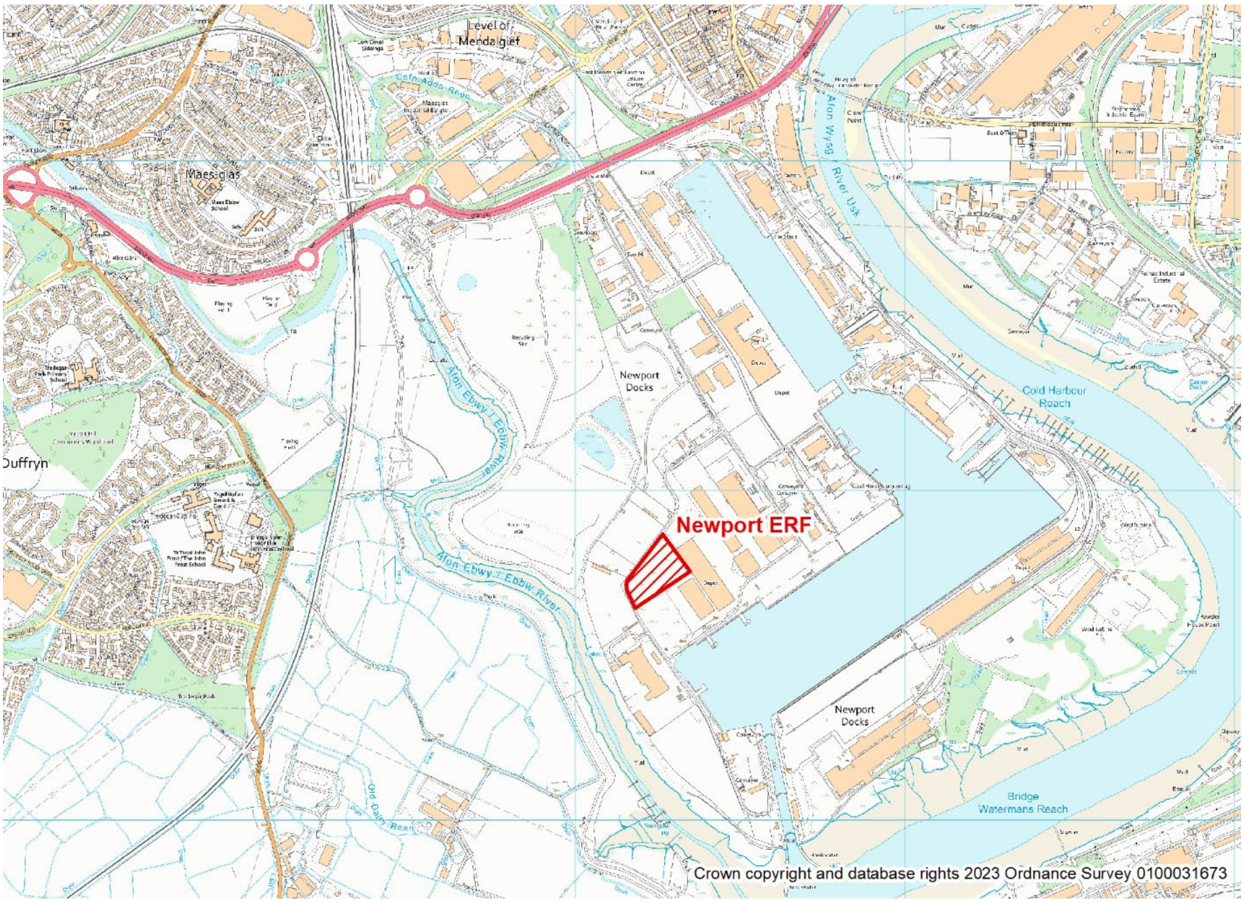

Figure 1.1: Site Location

2. LEGISLATION AND POLICY

2.1 The European Directive on Ambient Air and Cleaner Air for Europe

European Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, sets legally-binding Europe-wide limit values for the protection of public health and sensitive habitats. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Directives within a single, integrated instrument.

The pollutants included are sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter of less than 10 micrometres (μm) in aerodynamic diameter (PM_{10}), particulate matter of less than 2.5 μm in aerodynamic diameter ($PM_{2.5}$), lead (Pb), carbon monoxide (CO), benzene (C_6H_6), ozone (O_3), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

2.2 Air Quality Strategy for England, Scotland, Wales and Northern Ireland

The Government's policy on air quality within the UK is set out in the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland (AQS) published in July 2007[2], pursuant to the requirements of Part IV of the Environment Act 1995. The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The AQS is designed to be an evolving process that is monitored and regularly reviewed.

The AQS sets standards and objectives for ten main air pollutants to protect health, vegetation and ecosystems. These are benzene (C6H6), 1,3-butadiene (C4H6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10}, $PM_{2.5}$), sulphur dioxide (SO_2), ozone (O_3) and polycyclic aromatic hydrocarbons (PAHs).

The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO). These are general concentration limits, above which sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

The air quality objectives are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedances of the standard over a given period.

2 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – July 2007

For some pollutants there is both a long-term (annual mean) standard and a short-term standard. In the case of nitrogen dioxide (NO_2), the short-term standard is for a 1-hour averaging period, whereas for fine particulates (PM_{10}) it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants (e.g. temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road).

2.3 Air Quality (Wales) Regulations

Many of the objectives in the AQS were made statutory in Wales with the *Air Quality (Wales) Regulations 2000*[3] and the *Air Quality (Amendment) (Wales) Regulations 2002*[4] (the Regulations) for the purpose of Local Air Quality Management (LAQM).

The Air Quality Standards (Wales) Regulations 2010[5] have adopted into UK law the limit values required by EU Directive 2008/50/EC[6] and came into force on the 11th June 2010. These regulations prescribe the 'relevant period' (referred to in Part I2V of the Environment Act 1995) that local authorities must consider in their review of the future quality of air within their area. The regulations also set out the air quality objectives to be achieved by the end of the 'relevant period'.

Ozone is not included in the Regulations as, due to its trans-boundary nature, mitigation measures must be implemented at a national level rather than at a local authority level.

The EALs, air quality standards and objectives for the pollutants considered in the assessment are presented in Appendix B.

2.4 Local Air Quality Management (LAQM)

Part IV of the Environment Act 1995 also requires local authorities to periodically review and assess the quality of air within their administrative area. The Reviews have to consider the present and future air quality and whether any air quality objectives prescribed in Regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed air quality objectives are not likely to be achieved the authority concerned must designate that part an Air Quality Management Area (AQMA). For each AQMA, the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the air quality objectives. Local

3 The Air Quality (Wales) Regulations 2000 - Statutory Instrument 2000 No.1940
4 The Air Quality (Amendment) (Wales) Regulations 2002 - Statutory Instrument 2002 No.3182
5 The Air Quality Standards (Wales) Regulations 2010 – Statutory Instrument 2010 No. 1433
6 Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, on ambient air quality and cleaner air for Europe

authorities are not statutorily obliged to meet the objectives, but they must show that they are working towards them.

The Department of Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their Review and Assessment work[7]. This guidance, referred to in this chapter as LAQM.TG(16), has been used where appropriate in the assessment.

2.5 Newport City Council Review and Assessment of Air Quality

Newport City Council carries out frequent review and assessments of air quality within the area and produce Air Quality Progress Reports in accordance with the requirements of legislation.

Routine monitoring of NO_2 concentrations within Newport has identified a number of areas within the city where the annual mean air quality objective for nitrogen dioxide is exceeded. Therefore, the council has declared eleven AQMA. The nearest is at George Street 2.7 km to the north of the ERF facility.

The ERF facility does not lie within an AQMA.

2.6 Industrial Emissions Directive

The Industrial Emissions Directive (2010/75/EU) came into force on the 6th January 2011, replacing the seven existing Directives, including the Waste Incineration Directive (WID) and Large Combustion Plant Directive (LDPD), implemented through the Environmental Permitting Regulations (EPR).

The aim of the new Directive is to simplify the existing legislation and reduce administrative costs, whilst maintaining a high level of protection for the environment and human health. Permits will still be issued under EPR; however existing and new sites will be required to comply with the requirements of the IED, which places greater emphasis on new plant best available technology (BAT).

The design and operation of all new waste incinerations facilities must ensure compliance with emission limit values (ELVs) set out in the IED; these ELVs are summarised in Table 2.1.

7 Department for Environment, Food and Rural Affairs (Defra), (2016): Part IV The Environment Act 1995 Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16).

Table 2.1: IED Emission Limits (mg/Nm^3)	
Pollutant	Emission Limit (a)
Total Dust	10
Gaseous and vaporous organic substances, expressed as total organic carbon (TOC)	10
Sulphur Dioxide	50
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2	200
Carbon Monoxide	50
Hydrogen Chloride	10
Hydrogen Fluoride	1
Group I Metals (Cd, Tl)	0.05 (group total)
Group II Metals (Hg)	0.05
Group III Metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.5 (group total)
Dioxins and furans (PCDD/Fs)	0.1 x10^{-6}
(a) Dry gas at 273.15K, 101.3mb and 11% O_2	

The European Union Best Available Techniques (BAT) Reference Document (BREF) for Waste Incineration was issued as a final document (December 2019). The proposed facility does not currently have an Environmental Permit. Therefore, it will be classed as a new plant.

The BREF provides BAT Associated Emission Limits (AEL) for new plants and existing plants. For the purposes of this assessment, it is assumed that the plant will need to comply with the requirements for new plant. These ELVs are provided as a range of concentrations for each pollutant. Therefore, for the purposes of this assessment it is assumed that the plant will comply with the upper range of emissions as provided in Table 2.2.

Table 2.2: Assumed Emission Limits for the Assessment (mg/Nm^3)	
Pollutant	Emission Limit (a)
Total Dust	5
Gaseous and vaporous organic substances, expressed as total organic carbon (TOC)	10
Sulphur Dioxide	30
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2	120
Carbon Monoxide	50
Hydrogen Chloride	6
Hydrogen Fluoride	1
Group I Metals (Cd, Tl)	0.02 (group total)
Group II Metals (Hg)	0.02
Group III Metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.3 (group total)
Dioxins and furans (PCDD/Fs)	0.08×10^{-6}

(a) Dry gas at 273.15K, 101.3mb and 11% O_2

3. METHODOLOGY

3.1 Scope of the Assessment

The scope of the assessment has been determined in the following way:

- Review of air quality data for the area surrounding the site, including data from the Defra Air Quality Information Resource (UK-AIR);
- Desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and
- Review and modelling of emissions data which has been used as an input to the Breeze AERMOD dispersion modelling assessment.

The assessment for the proposed installation comprises a review of emission parameters for the combustion plant and dispersion modelling to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

Predicted ground level concentrations are compared with relevant air quality standards for the protection of health and critical levels/ loads for the protection of sensitive ecosystems and vegetation.

3.2 Dispersion Model Parameters

The predicted impact of the proposed installation on local air quality has been undertaken using the Breeze AERMOD 10 (US EPA Version 21112) dispersion model[8].

For the assessment, emission limits for new plant (refer to Table 2.2) have been assumed for the purposes of the modelling assessment and the plant is assumed to be operating at full load, continually throughout the year, ensuring that a worst-case assessment of impacts is presented.

For the Group III trace metal predictions, it has been assumed in accordance with the Environment Agency's metals guidance[9], that each of the metals is emitted at the maximum ELV (assumed to be 0.3 mg/Nm^3) as a worst-case. The same approach has also been adopted for the Group I and II metals.

If the screening criteria are not met, maximum emission concentrations for energy from waste (EFW) plants have been used, as specified in the guidance.

8 AERMOD is a steady-state Gaussian dispersion model that represents an advanced t promulgated dispersion model. AERMOD is considered the most complete air quality modelling system available on the market and has therefore been selected for this modelling exercise.
9 Releases from Waste Incinerator, Guidance on Assessing Group 3 Metal Stack Emissions from Incinerators – Version 4

An emission limit of 9 x 10^{-5} mg/Nm^3 has been assumed for PAH (benzo(a)pyrene based on the Defra (WR0608) report on emissions from waste management facilities[10]. Information on PCB emissions has also been obtained from the Defra report WR0608. Based on the information provided, a maximum emission concentration of 3.6 x 10^{-9} mg/m^3 is assumed. For ammonia, an emission concentration of 10 mg/Nm^3 has been assumed for the assessment based on the BREF upper limit for New Plant.

A summary of the input parameters used in the assessment are identified in **Appendix C**.

3.2.1 Meteorological Data

Dispersion modelling has been undertaken using five years (2014-2018) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from a meteorological observing station at Rhoose (Cardiff Airport) (approximately 30 km southwest of the site) has been used for the assessment, which is the most representative data currently available for the area.

Wind roses for each year of meteorological data are presented in **Appendix D.**

3.2.2 Building Downwash / Entrainment

The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to a phenomenon called downwash. This occurs when a building distorts the wind flow, creating zones of increased turbulence. Increased turbulence causes the plume to come to ground earlier than otherwise would be the case and result in higher ground level concentrations closer to the stack.

Downwash effects are only significant where building heights are greater than 30 to 40% of the emission release height. The downwash structures also need to be sufficiently close for their influence to be significant. For a stack height of 50 m, buildings in excess of 20 m would need to be included. A summary of the buildings included within the dispersion model are provided in Table 3.1.

Table 3.1: Building Downwash Structures

Building	Easting	Northing	Height	Dimensions	Angle
Boiler building	331319	184778	39 m	68 x 33 m	145.4
Unloading/fuel bunker	331263	184739	15 m	110 x 33 m	145.4
ACC	331269	184775	22.6 m	30 x 25 m	145.4
Turbine building	331282	184793	17.1 m	15.4 x 32 m	145.4
Silo	331304	184780	29 m	Radius = 2.85 m	

10 WR 0608 Emissions from Waste Management Facilities, ERM Report on Behalf of Defra (July 2011)

3.2.3 Nitric Oxide to NO_2 Conversion

Oxides of nitrogen (NO_x) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO_2. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O_3).

A conversion ratio of 70% NOx:NO_2 has been assumed for comparison of predicted concentrations with the long-term objectives for NO_2. A conversion ratio of 35% has been utilised for the assessment of short-term impacts.

3.3 Significance Criteria

3.3.1 Environmental Permitting

The Environment Agency has developed criteria for assessing the significance of an impact compared with relevant air quality standards and background air quality[11]. This methodology is applicable to permit applications in Wales as stated by Natural Resources Wales (NRW). A process contribution (PC) is considered significant if:

- The long-term PC > 1% of the long-term air quality standard;
- The short-term PC > 10% of the short-term air quality standard.

At 1% of the long-term air quality standard, the impact of a development is unlikely to be significant compared with background air quality. Both the short and long-term criteria are also designed to ensure that there is a substantial safety margin to protect public health and the environment.

If the screening criteria are not met, the process contribution should be considered in combination with relevant ambient background pollutant concentrations. The air quality standards are likely to be met if:

- The long-term PC + background concentration < 70% of the air quality standard;
- The short-term PC < 20% (air quality standard – short-term background concentration), where the short-term background concentration is assumed to be twice the long-term background concentration.

3.3.2 Habitat Sites

The Environment Agency's risk assessment guidance specifies criteria to enable the potential significance of an impact to be determined. For the process contribution (PC), the impact is deemed not significant if

11 Environment Agency Risk Assessment Guidance (https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit)

the annual mean PC is less than 1% of the critical level (or air quality objective) and the short-term PC is less than 10% of the critical level (or air quality objective). If either of these criteria is exceeded, they are not necessarily significant however, it is then necessary to consider the total predicted environmental concentration or deposition (PC plus the background contribution) as discussed above.

For local wildlife sites (SINCs, SLINC's, NNRs, LNRs and ancient woodland), a process contribution (PC) is considered not significant if:

- the long-term PC < 100% of the long-term critical level;
- the short-term PC < 100% of the short-term critical level.

3.4 Sensitive Receptors

Specific receptors have been identified where people are likely to be regularly exposed for prolonged periods of time (e.g. residential areas). The location of the discrete sensitive receptors is presented in Table 3.2 and Figure 3.1 (Receptor R11 is not shown as it is located further to the north of the map).

Table 3.2: Human Health Receptors

ID	Receptor	Type	Easting	Northing
R1	Lighthouse Road	Residential	330048	183533
R2	Duffryn High School	School	330037	184853
R3	Edney Way	Residential	329973	185261
R4	Maesglas Crescent	Residential	330113	185752
R5	Wolseley Street	Residential	331425	186235
R6	St Michael Street	Residential	331843	186770
R7	Spytty Lane	Residential	333355	186762
R8	New Dairy Farm	Residential	330640	183949
R9	Spytty Park	Residential	333816	186267
R10	Lysaght	Residential	332752	186506
R11	George Street	AQMA/Residential	331384	187450

Pollutant concentrations have been predicted at both discrete receptor locations and over a 6 km by 6 km Cartesian grid of 75 m resolution.

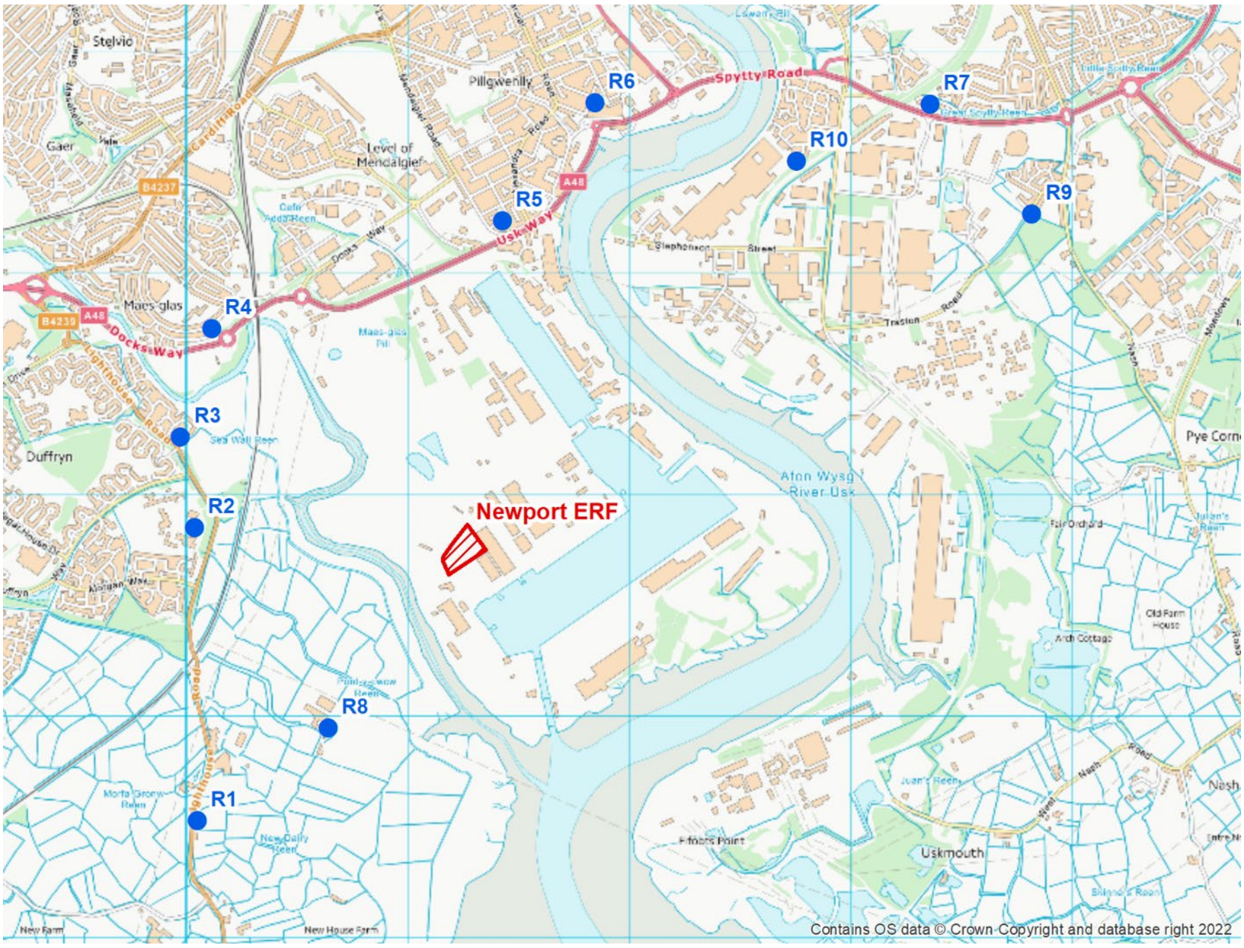

Figure 3.1: Sensitive Human Health Receptor Locations

3.5 Habitat Assessment

The Environment Agency's risk assessment guidance states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive[12];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive[13;] and
- Ramsar Sites designated under the Convention on Wetlands of International Importance[14.]

12 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

13 Council Directive 79/409/EEC on the conservation of wild birds

14 Ramsar (1971), The Convention of Wetlands of International Importance especially as Waterfowl Habitat.

Within 2 km of the source:

- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- National Nature Reserves (NNR);
- Local Nature Reserves (LNR);
- local wildlife sites (Sites of Interest for Nature Conservation, SINC and Sites of Local Interest for Nature Conservation, SLINC); and
- ancient woodland.

Habitat receptor designations and locations relevant to the assessment are presented in Table 3.3 and the location indicated in Figure 3.2. These include the Severn Estuary and River Usk European sites. In addition, there are a number of SINC's and ancient woodlands within 2 km of the site. These are identified in the figures provided in Appendix E.

Table 3.3: Sensitive Habitat Receptors

Receptor	Designation
Severn Estuary	Ramsar, SAC, SPA, Ramsar site & SSSI
River Usk	SAC &SSSI
Gwent Levels – St Brides	SSSI
Newport Wetlands	SSSI & LNR
Duffryn Pond	SINC
Julian's Gout Land	SINC
Gwent Wetland Reserve	SINC
Marshall's	SINC
Afon Ebbw River	SINC
Numerous Ancient Woodland	Ancient Woodland

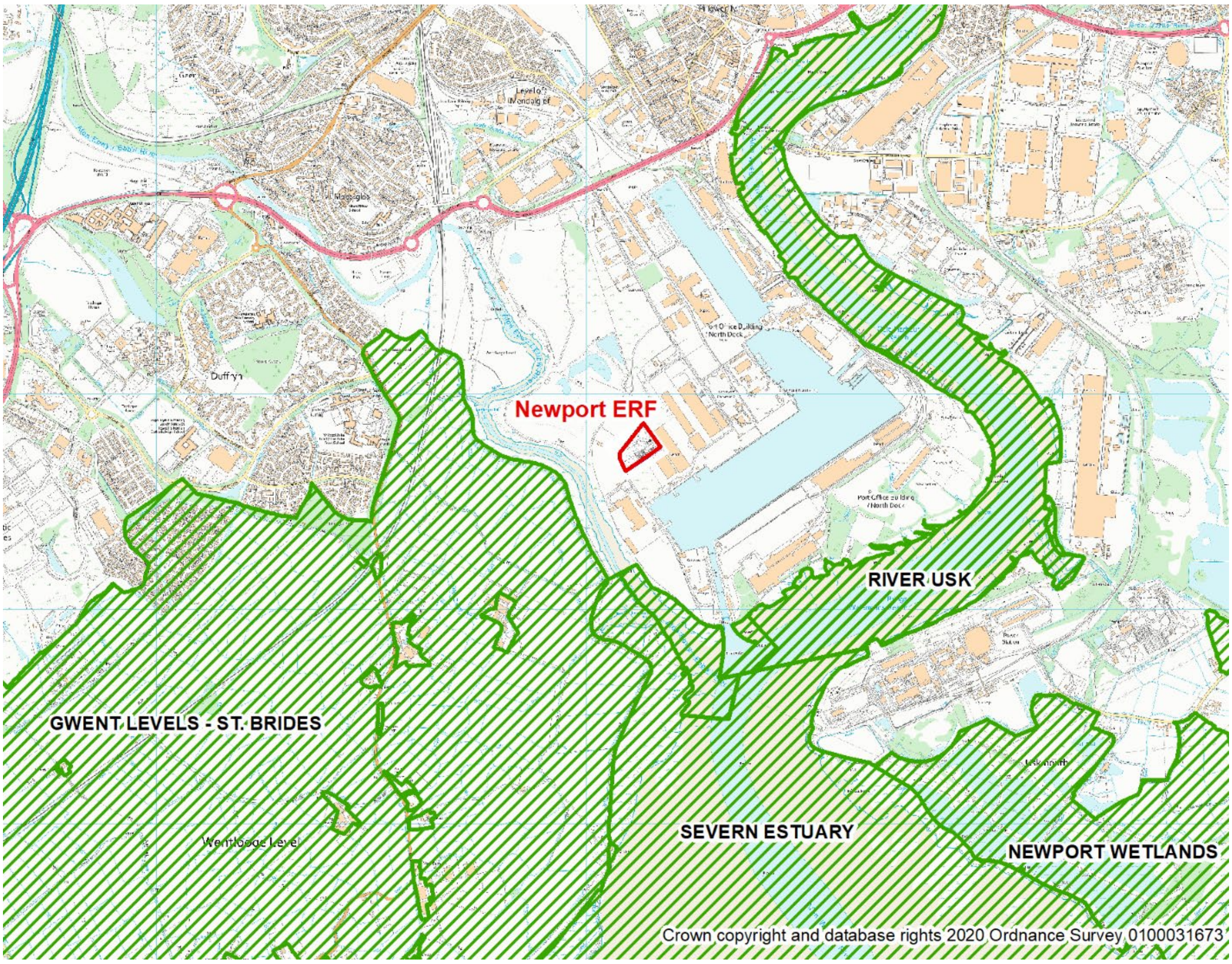

Figure 3.2: Sensitive European/SSSI Habitat Receptor Locations

Due to the extent of the European/SSSI habitat sites in close proximity to the site, these have been modelled by a Cartesian grid of 75 m resolution to enable the maximum impact to be determined. For the LWS, these have been represented by a number of discrete receptors depending on the extent of the habitat. LWS receptor locations are presented in Figure 3.3. Where multiple receptors are provided for a habitat site, the predicted maximum is provided for comparison with critical levels and critical loads.

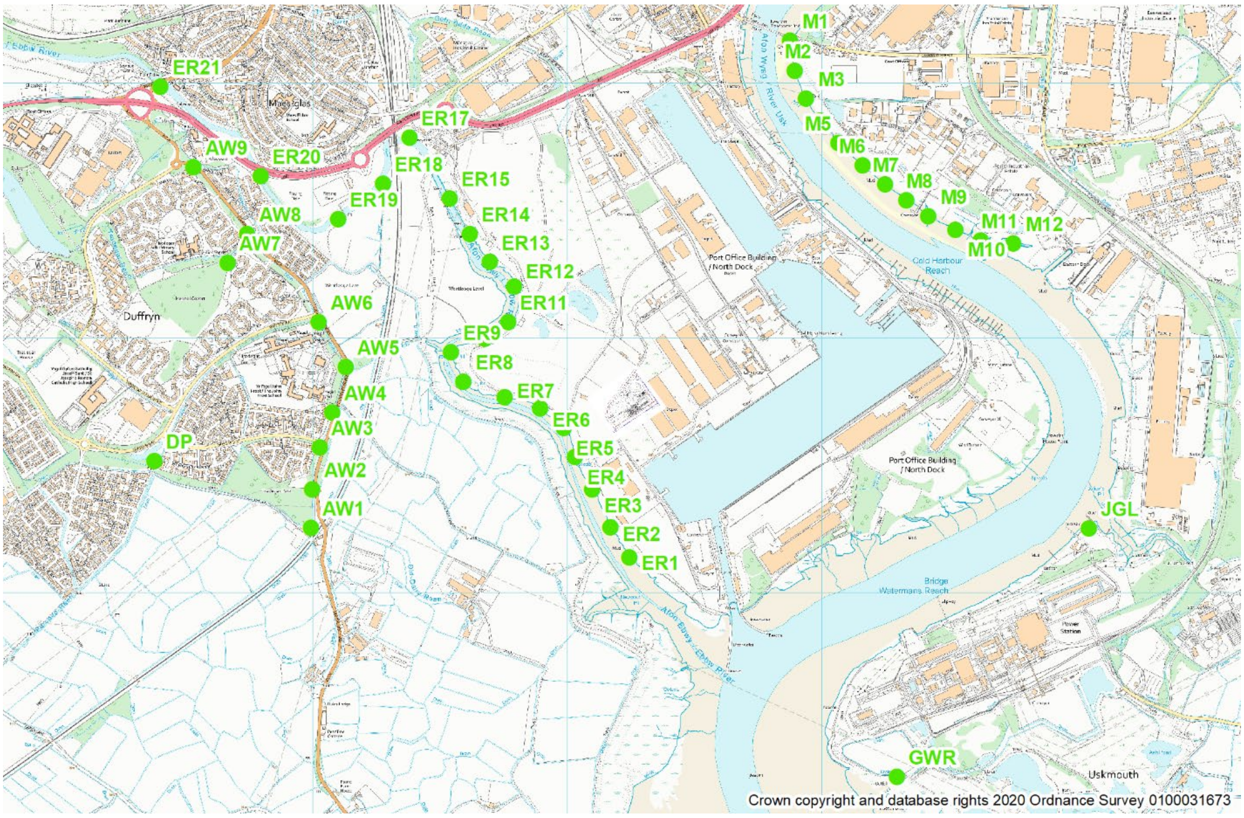

Figure 3.3: LWS Habitat Receptor Locations

Background airborne NOx, NH_3 and SO_2 concentrations have been obtained from the Air Pollution Information System (APIS) for use in the assessment.

The modelled ground level pollutant concentrations are used to predict deposition rates, using typical deposition velocities. A summary of typical NO_2, NH_3, SO_2 and HCl dry deposition velocities is presented in Table 3.4.

Table 3.4: Dry Deposition Velocities (m/s)		
Pollutant	Grassland	Woodland
Nitrogen Dioxide (NO_2)	0.0015	0.0030
Ammonia (NH_3)	0.02	0.03
Sulphur Dioxide (SO_2)	0.012	0.024
Hydrogen Chloride (HCl)	0.025	0.06

The predicted nitrogen deposition rates assume a 100% NOx: NO_2 conversion. This represents a worst-case for the assessment since nitric oxide (NO) has a lower deposition velocity than NO_2 and consequently results in lower deposition rates.

Predicted ground level concentrations and acidification/ deposition rates are compared with relevant air quality standards, critical levels and critical loads for the protection of sensitive ecosystems and vegetation (see Appendix E).

4. BASELINE CONDITIONS

4.1 Nitrogen Dioxide

Automatic monitoring of nitrogen oxides (NOx and NO_2) in 2021 was undertaken by Newport City Council at two locations within the city (St Julian's High School and M4 Old Barn). Both monitoring sites are located close to Junction 25 of the M4 but the St Julian's High School site is an urban background site and the M4 Old Barn is a roadside site. They are both located in excess of 5 km of the ERF facility and would not be representative of air quality at the site. In addition, monitoring of NO_2 was undertaken at 81 passive diffusion tubes sites in 2021. In 2019 (data for 2020 and 2021 not considered due to the COVID pandemic), there were five monitoring sites within 2.5 km of the ERF facility. The location of these is presented in Figure 4.1. A description of these monitoring sites is provided in Table 4.1. These are all roadside monitoring locations.

Table 4.1: Newport City Council Monitoring Sites of Relevance to the Assessment

Monitoring Site	Type	Pollutants	Distance from Relevant Exposure	Distance from Kerb of Nearest Road
NCC13B 76 Capel Crescent	Roadside	NO_2	3.0 m	1.6 m
NCC19C 94 Mendalgief Road	Roadside	NO_2	4.7 m	4.7 m
NCC55 116 Alexandra Road	Roadside	NO_2	2.4 m	0.3 m
NCC59 99 Stow Hill	Roadside	NO_2	2.4 m	2.4 m
NCC79 708 Corporation Road	Roadside	NO_2	5.0 m	2.2 m

Source: 2020 Air Quality Progress Report for Newport City Council, Air Quality Newport 2020

A summary of the annual mean background NO_2 concentrations measured at the six diffusion tube monitoring sites from 2017 to 2019 is presented in Table 4.2.

Table 4.2: Annual Mean NO_2 Concentrations (µg/m^3)

Monitoring Site	2017	2018	2019
NCC13B 76 Capel Crescent	23.2	21.7	23.0
NCC19C 94 Mendalgief Road	21.5	19.4	19.8
NCC55 116 Alexandra Road	29.4	26.8	27.6
NCC59 99 Stow Hill	28.7	28.1	28.4
NCC79 708 Corporation Road	34.5	35.0	35.8

Source: 2020 Air Quality Progress Report for Newport City Council, Air Quality Newport 2020

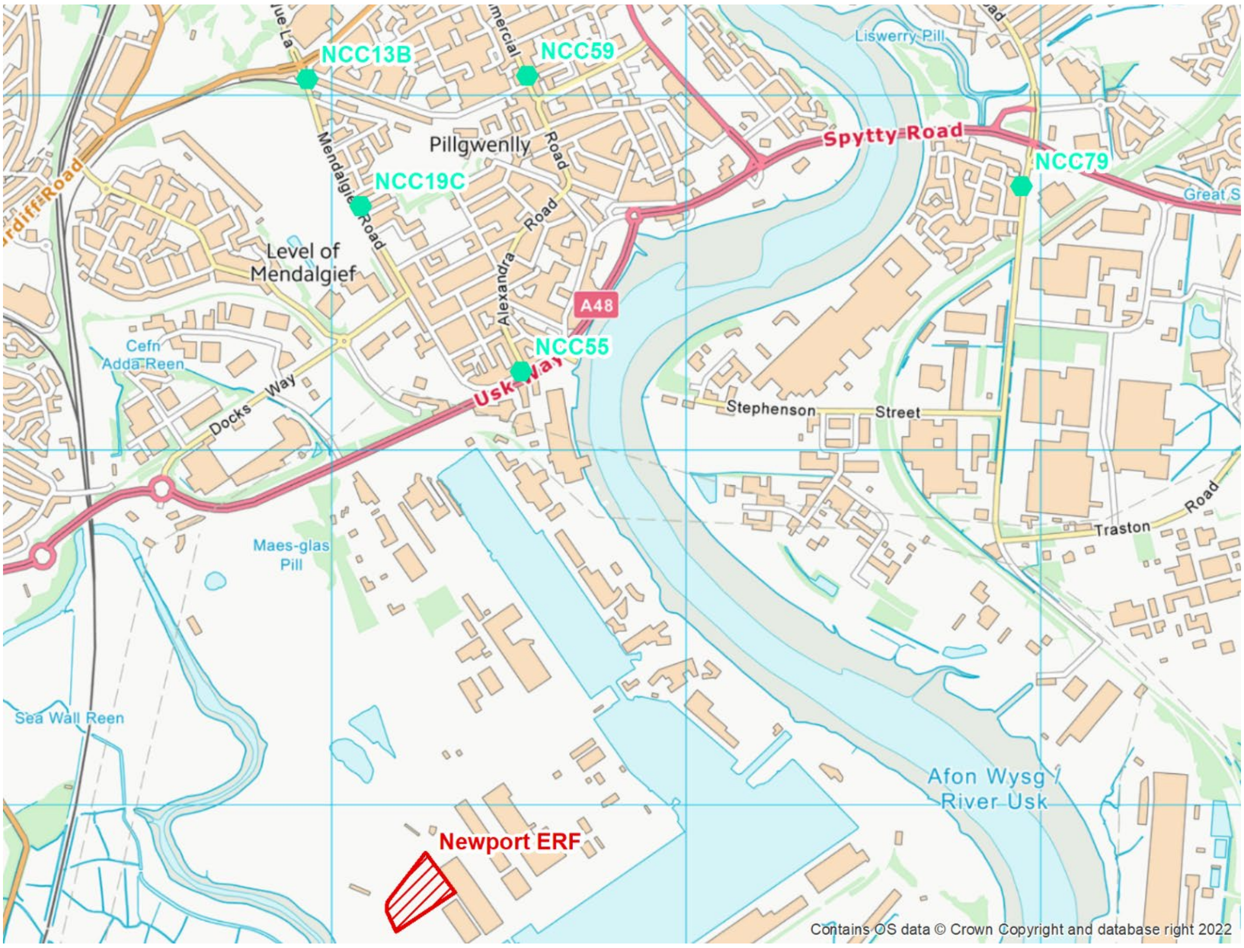

Figure 4.1: Newport City Council Monitoring Locations

Measured annual mean concentrations of NO_2 at all monitoring locations are below the annual mean air quality objective (AQO) of 40 µg/m^3. As an average for the three years, highest concentrations were measured at Corporation Road at 35.1 µg/m^3 (88% of the AQO). Lowest concentrations were measured at NCC19C at 20.2 µg/m^3 (51% of the AQO). For the three years and five monitoring sites, the average annual mean NO_2 concentration was 26.9 µg/m^3 (67% of the AQO).

For comparison, annual mean NO_2 background concentrations for 2022 have been obtained from the Defra UK Background Air Pollution Maps[15]. The latest background maps (for NO_2, PM_{10} and $PM_{2.5}$) were issued in 2020 and are based on 2018 monitoring data.

The highest 2022 mapped annual mean background concentration for the nine 1 km^2 grids surrounding the site is 16.2 µg/m^3 (41% of the AQO) which includes a contribution from traffic on the primary routes through the area. Whilst the Defra mapped data indicates that background NO_2 concentrations in the

15 http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

vicinity of the site are likely to be lower than in the city centre and at roadside monitoring sites, the average concentration measured at the NCC19C diffusion tube site of 20.2 µg/m^3 has been assumed to ensure a conservative assessment for this key pollutant.

4.2 Carbon Monoxide (CO), Sulphur Dioxide (SO_2) and Total Organic Carbon (as Benzene)

Monitoring of CO is not carried out by Newport City Council. Therefore, background concentrations have been obtained from the Defra maps for use in the assessment. The mapped concentrations are based on 2001 monitoring data. For CO, factors are available to project the concentrations to future years[16]. Mapped concentrations for 2022 (as the maximum of the nine 1 km^2 grids surrounding the site) are provided in Table 4.3. Data are corrected for 2021 with the application of a factor of 0.448.

Monitoring of SO_2 concentrations is also carried out at the CM2 AURN urban background site. Annual mean concentrations for the four year period 2015 to 2018 varied between 1.7 and 2.3 µg/m^3. There were no measured exceedances of the 24-hour, 1-hour or 15-minute mean air quality objectives for SO_2 during this period. For comparison, background concentrations have been obtained from the Defra maps. The 2022 SO_2 concentrations are assumed to be 100% of the 2001 estimates and represent a worst-case. For the nine 1 km^2 surrounding the Site, the maximum annual mean SO_2 concentration is provided in Table 4.3. At 6.8 µg/m^3, this is a factor of three higher than measured at the CM2 monitoring site.

Monitoring of benzene concentrations is not undertaken by Newport City Council. Therefore, background concentrations have been obtained from the Defra maps for use in the assessment. The 2001 mapping includes projected benzene concentrations for 2010 and these are assumed to be representative of the 2021 concentrations for the purposes of the assessment. Maximum concentrations for the nine 1 km^2 surrounding the site are provided in Table 4.3.

Table 4.3: Defra 2021 Mapped SO_2 CO and Benzene Background Concentrations

Pollutant	Concentration (µg/m^3)	AQO / EAL
Sulphur Dioxide (SO_2)	13.0	n/a
Carbon Monoxide (CO)	136	n/a
Benzene	0.35	5

For the purposes of the assessment, the Defra 2022 background concentrations are assumed to be representative of background concentrations of SO_2, CO and benzene (as provided in Table 4.3).

16:http://laqm.defra.gov.uk/tools-monitoring-data/year-adjustment.html

4.3 Particulate Matter (PM_{10} and $PM_{2.5}$)

PM_{10} and $PM_{2.5}$ concentrations are measured at the St Julian's automatic monitoring site but measured concentrations are not considered to be representative of air quality at ERF facility site. The mapped concentrations of PM_{10} and $PM_{2.5}$ for 2022 are summarised in Table 4.4 as the maximum of the nine 1 km^2 grids surrounding the site. Mapped concentrations of PM_{10} are 32% of the air quality objective of 40 $\mu g/m^3$. For $PM_{2.5}$, the mapped concentrations are 41% of the EU limit value of 20 $\mu g/m^3$.

Table 4.4: Defra 2021 Mapped PM_{10} and $PM_{2.5}$ Background Concentrations

Pollutant	Concentration ($\mu g/m^3$)	AQO / EU Limit Value
PM_{10}	12.9	40
$PM_{2.5}$	8.1	20

For the purposes of the assessment, the Defra 2022 mapped concentrations are assumed to be representative of background concentrations of PM_{10} and $PM_{2.5}$ (as provided in Table 4.4).

4.4 Hydrogen Chloride

Ambient monitoring of hydrogen chloride is carried out as part of the Defra Acid Gas and Aerosol Network at a number of locations around the UK. The closest monitoring site is at Rosemaund, a rural background site located to the northeast of Hereford, approximately 70 km north of the site. For 2015 (no data available since), the annual average mean HCl concentration was 0.26 $\mu g/m^3$. This concentration is assumed to provide a reasonable estimate of the background concentration of HCl at the site.

4.5 Hydrogen Fluoride

Monitoring of ambient levels of hydrogen fluoride is not currently carried out in the UK. However, the Expert Panel on Air Quality Standards (EPAQS) report on halogen and hydrogen halides in ambient air [17] cites a modelling study which suggests that the typical natural background HF concentration is 0.5 $\mu g/m^3$, with an elevated background of 3 $\mu g/m^3$ where there are local anthropogenic emission sources.

For the purposes of the assessment, the natural background HF concentration of 0.5 $\mu g/m^3$ is assumed to be applicable at sensitive human health and habitat receptors in the vicinity of the site.

4.6 Ammonia (NH_3)

Ambient monitoring of ammonia (NH_3) concentrations is carried out as part of the National Ammonia Monitoring Network (NAMN) at 85 locations around the UK. At the closest monitoring site (Castle Cary) the annual mean monitored NH_3 concentration for 2017 to 2019 varied between 3.7 and 4.3 $\mu g/m^3$ with

17 EPAQS (February 2006), Guidelines for Halogen and Hydrogen Halides in Ambient Air for Protecting Human Health Against Acute Irritancy Effects.

an average for the three years of 4.0 µg/m^3. It is assumed that the average of the concentrations (4.0 µg/m^3) measured during this three year period is a reasonable estimate of the background NH_3 concentration in the vicinity of the site. However, it is noted that Caste Cary is a rural background site and likely to experience higher concentrations of ammonia than urban locations.

4.7 Trace Metals

Defra has undertaken monitoring of trace elements at a number of locations in the UK since 1976 as part of the UK Urban and Rural Heavy Metals Monitoring Networks. One monitoring site is classed as a suburban industrial site and is considered to be characteristic of trace metal concentrations at the site. The monitoring site (Pontardawe Brecon Road) is located approximately 60 km to the west of the site. The average concentrations measured at this site between 2017 and 2019 are presented in Table 4.5.

Table 4.5: Annual Mean Trace Metal Concentrations (ng/m^3)

Metal	Pontardawe Brecon Road	EAL
Antimony (Sb)	Not measured	5,000
Arsenic (As)	1.0	3
Cadmium (Cd)	0.29	5
Chromium (Cr)	2.5	5,000
Hexavalent Chromium (Cr(VI))	0.50 (a)	0.2
Cobalt (Co)	0.37	1,000
Copper (Cu)	4.9	10,000
Lead (Pb)	5.9	250 – 500
Manganese (Mn)	3.8	150
Mercury (Hg) (b)	Not measured	250
Nickel (Ni)	5.4	20
Thallium (Tl)	Not measured	1,000
Vanadium (V)	0.74	5,000

(a) Assumed to be 20% of total chromium
(b) Total particulate and vapour

With the exception of Cr(VI), all the measured concentrations are well below their respective EAL's. Guidance issued by the Environment Agency[18] for the assessment of Group 3 metals, states that for screening purposes it should be assumed that Cr(VI) comprises 20% of the total background chromium. On this basis the average Cr(VI) concentration at the site substantially exceeds the EAL.

For the purposes of the assessment, the concentrations measured at Pontardaew Brecon Road are assumed to be reasonably representative of the baseline trace metal concentrations at the site.

18 Releases from Waste Incinerator, Guidance on Assessing Group 3 Metal Stack Emissions from Incinerators – Version 4

4.8 Dioxins and Furans

Monitoring of PCDD/Fs is currently carried out by Defra at five locations in the UK (Hazelrigg, High Muffles, Manchester, Auchencorth Moss and Weybourne) as part of the Toxic Organic Micropollutants (TOMPs) Network. Historically monitoring was also carried in in London.

To provide an indication of the range of PCDD/F concentrations that occur in the UK, a summary of the annual mean concentrations measured between 2013 and 2015 is presented in Table 4.6.

Table 4.6: UK PCDD/Fs Concentrations (fg TEQ/m^3)

Monitoring Site	Type	2013	2014	2015
London	Urban background	3.5	2.9	4.4
Manchester	Urban background	10	17	6
Auchencorth Moss	Rural background	0.87	0.01	0.01
High Muffles	Rural background	0.6	1.1	0.5
Hazelrigg	Rural background	2.0	2.6	5.3
Weybourne	Rural background	2.3	1.6	1.4

The average concentration measured at the two urban background monitoring sites from 2013 to 2015 is 7.3 fg/m^3 and is assumed to be reasonably representative of the baseline dioxin and furan concentration at the site and nearby sensitive receptors.

4.9 Polycyclic Aromatic Hydrocarbons (as benzo[a]pyrene)

Monitoring of PAHs is carried out as part of the UK PAH network. Sampling is carried out at 31 sites across England, Wales, Scotland and Northern Ireland. Monitoring of benzo(a)pyrene is carried out at the St Julian's School. Although not entirely representative of the site and surroundings, it is the nearest PAH monitoring site.

A summary of concentrations measured in the UK is issued by the National Physical Laboratory (NPL) on behalf of Defra on an annual basis. The most recent report was published in June 2016 and provides annual mean BaP concentrations measured by the network in 2015 [19]. The annual mean concentration for the Newport site was 0.19 ng/m^3.

For the purposes of the assessment, it is assumed that the annual mean background concentration is 0.19 ng/m^3 as measured at the Newport site.

19 Annual Report for 2015 on the UK PAH Monitoring and Analysis Network, NPL Report ENV 10, June 2016.

4.10 Polychlorinated Biphenyls

Monitoring of PCBs is currently carried out by Defra at six locations in the UK as part of the TOMPs Network. The average PCB concentration measured at the urban background monitoring sites (London and Manchester) from 2013 to 2015 is 85 pg/m^3 (0.085 ng/m^3) and is assumed to be reasonably representative of the baseline PCB concentration at the site and nearby sensitive receptors.

4.11 Summary of Background Concentrations

A summary of the annual mean and short-term background concentrations assumed for the assessment is presented in Table 4.7. The concentrations are assumed to be representative of future year concentrations. Since pollutant concentrations are expected to decline in the future, this methodology ensures that the worst-case impacts are determined (i.e. future impacts combined with existing air quality).

Table 4.7: Summary of Background Concentrations

Pollutant	Annual Mean	Short-Term
Particles (PM_{10})	12.9 µg/m³	15.2 µg/m³ (a)(b)
Particles ($PM_{2.5}$)	8.2 µg/m³	n/a
Nitrogen Dioxide (NO_2)	20.2 µg/m³	40.4 µg/m³ (a)
Sulphur Dioxide (SO_2)	13.0 µg/m³	15.3 µg/m³ (a)(b) 26.0 µg/m³ (a) 34.8 µg/m³ (a)(d)
Carbon Monoxide (CO)	136 µg/m³	190 µg/m³ (a)(c) 272 µg/m³ (a)
Hydrogen Fluoride (HF)	0.5 µg/m³	1.0 µg/m³ (a)
Hydrogen Chloride (HCl)	0.26 µg/m³	0.52 µg/m³ (a)
Ammonia (NH_3)	4.0 µg/m³	8.0 µg/m³ (a)
Benzene	0.35 µg/m³	0.41 µg/m³ (a)(b)
Dioxins and Furans (PCDD/Fs)	7.3 fg/m³	n/a
Antimony (Sb)	No data available	n/a
Arsenic (As)	1.0 ng/m³	2.0 µg/m³ (a)
Cadmium (Cd)	0.29 ng/m³	n/a
Chromium	2.5 ng/m³	5.0 ng/m³ (a)
Hexavalent Chromium (Cr(VI))	0.50 ng/m³	n/a
Cobalt (Co)	0.37 ng/m³	0.74 ng/m³ (a)
Copper (Cu)	4.9 ng/m³	9.8 ng/m³
Lead (Pb)	5.9 ng/m³	n/a
Manganese (Mn)	3.8 ng/m³	7.6 ng/m³ (a)
Mercury (Hg)	No data available	n/a
Nickel (Ni)	5.4 ng/m³	n/a
Thallium (Tl)	No data available	n/a
Vanadium (V)	0.74 ng/m³	0.90 ng/m³ (a)(b)
Polycyclic Aromatic Hydrocarbons (PAH, as BaP)	0.19 ng/m³	n/a
Polychlorinated biphenyls (PCBs)	0.085 ng/m³	0.17 ng/m³ (a)

(a) 1-hour mean background concentration estimated by multiplying the annual mean by a factor of 2 in accordance with the Environment Agency’s Risk Assessment Guidance.

(b) 24-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.59 in accordance with the Environment Agency’s Risk Assessment Guidance.

(c) 8-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.70 in accordance with the Environment Agency’s Risk Assessment Guidance.

(d) 15-minute mean background concentration estimated by multiplying the 1-hour mean by a factor of 1.34 in accordance with the Environment Agency’s Risk Assessment Guidance.

5. ASSESSMENT OF IMPACT

5.1 Human Health Impact

5.1.1 Introduction

Predicted pollutant concentrations (PC) for the five years of meteorological data are presented as the maximum concentration for each of the discrete receptors identified in Section 3.4. Emissions from the facility are assumed to be at the BREF emission limits for the thermal treatment of waste for new plant.

The maximum PC is added to the estimated background concentration for the area (see Table 4.8) to give the total predicted environmental concentration (PEC) for comparison with the relevant air quality objectives. The significance of the impacts has been assessed in accordance with the Environment Agency's Risk Assessment Guidance.

5.1.2 Nitrogen Dioxide (NO_2)

The maximum predicted annual mean and 99.8th percentile of 1-hour mean ground level NO_2 concentrations are presented in Table 5.1.

Table 5.1: Predicted Concentrations of NO_2

Receptor	Annual Mean		99.8th Percentile of 1-hour Means
	PC (µg/m^3)	PC (%age AQO)	PC (ug/m^3)
Maximum Predicted	2.2	5.6%	11.9
R1. Lighthouse Road	0.12	0.3%	1.9
R2. Duffryn High School	0.18	0.5%	2.6
R3. Edney Way	0.21	0.5%	3.0
R4. Maesglas Crescent	0.18	0.5%	2.8
R5. Wolseley Street	0.14	0.4%	2.9
R6. St Michael Street	0.08	0.2%	1.9
R7. Spytty Lane	0.10	0.3%	1.3
R8. New Dairy Farm	0.19	0.5%	3.6
R9. Spytty Park	0.13	0.3%	1.2
R10. Lysaght	0.12	0.3%	1.6
R11. George Street AQMA	0.06	0.1%	1.3
AQO (µg/m^3)	40		200
Background (µg/m^3)	20.2		40.4
Maximum PC as %age of AQO	5.6%		6.0%
Maximum PEC as %age of AQO	56.1%		26.2%

Maximum predicted annual mean NO_2 concentrations are assessed as potentially significant (>1% of the AQO) as the maximum predicted anywhere within the model domain. However, maximum total predicted concentrations are less than 70% of the AQO at all locations. Therefore, it is concluded that the annual mean AQO would be met.

The hourly-mean predicted concentrations are less than 10% of the AQO at all locations including the maximum predicted. Therefore, it is concluded that the short-term impact of emissions at all locations would be not significant.

Predicted annual and 99.8th percentile of hourly mean NO_2 concentrations for the most recent year of meteorological data (2018), are presented as contour plots in Figures 5.1 and 5.2 respectively.

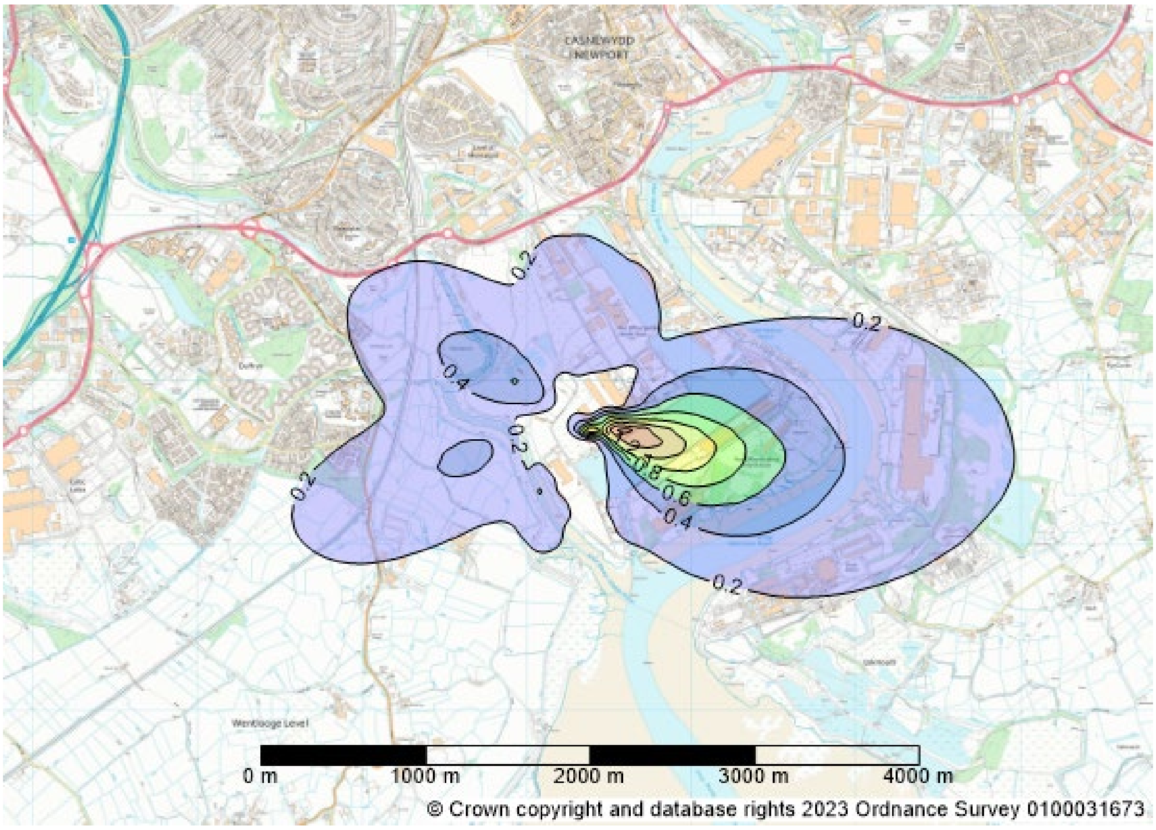

Figure 5.1: Predicted Annual Mean NO_2 Concentrations (µg/m^3)

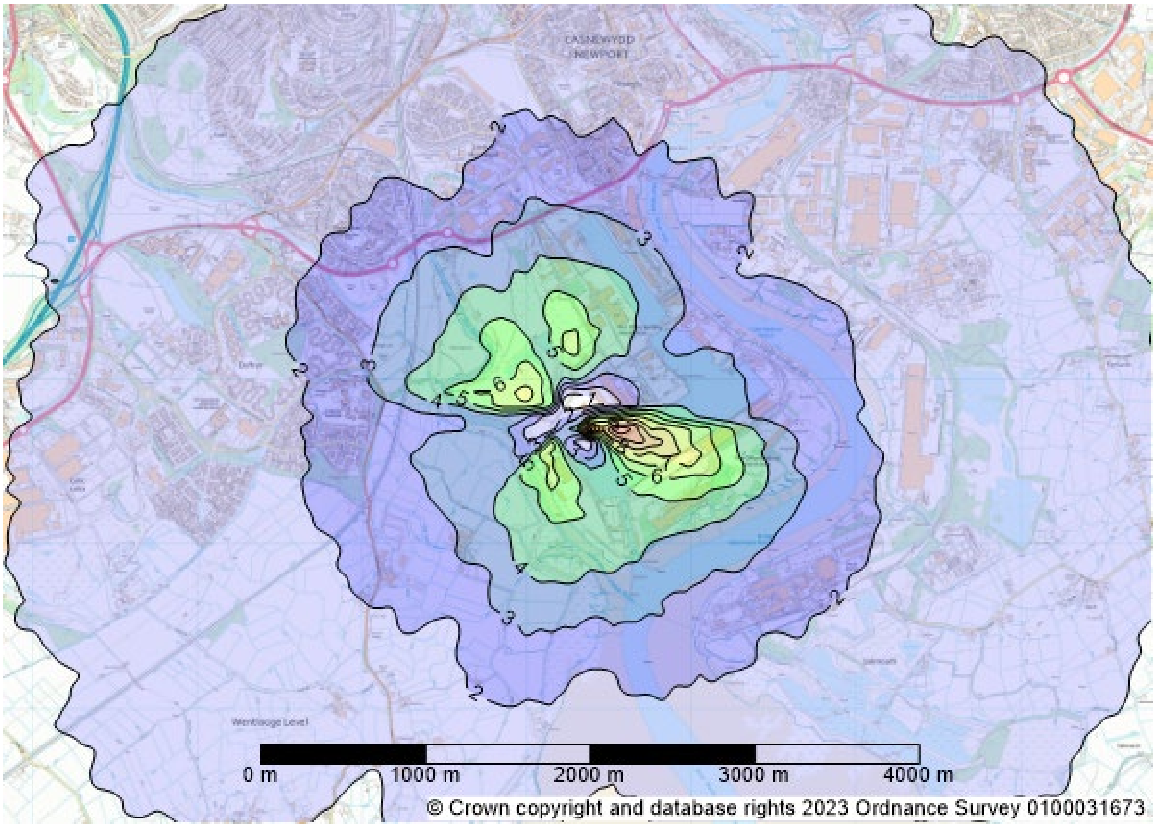

Figure 5.2: Predicted 99.8th Percentile of 1-Hour Mean NO_2 Concentrations (µg/m^3)

5.1.3 Carbon Monoxide (CO)

Maximum predicted 8-hour and 1-hour mean ground level CO concentrations are presented in Table 5.2.

Table 5.2: Predicted CO Concentrations		
Receptor	8-Hour Mean	1-Hour Mean
	PC ($\mu g/m^3$)	PC ($\mu g/m^3$)
Maximum predicted	12.2	17.8
R1. Lighthouse Road	1.8	2.7
R2. Duffryn High School	2.4	4.5
R3. Edney Way	2.7	6.7
R4. Maesglas Crescent	2.4	7.0
R5. Wolseley Street	2.3	6.2
R6. St Michael Street	1.4	5.1
R7. Spytty Lane	1.3	3.5
R8. New Dairy Farm	3.9	5.3
R9. Spytty Park	1.3	3.2
R10. Lysaght	1.5	2.8
R11. George Street AQMA	1.0	4.1
AQO / EAL ($\mu g/m^3$)	10,000	30,000
Background ($\mu g/m^3$)	190	272
Maximum PC as %age of AQO	0.1%	0.1%
Maximum PEC as %age of AQO	2.0%	1.0%

The maximum 8-hour and 1-hour concentrations are well below the Environment Agency's 10% short-term screening criteria. Therefore, the impact of CO emissions from the proposed installation on local air quality is considered not significant.

5.1.4 Sulphur Dioxide (SO_2)

The predicted SO_2 concentrations (PC) at identified sensitive receptor locations are presented in Table 5.3.

Table 5.3: Predicted SO_2 Concentrations			
Receptor	99.2nd Percentile of 24-Hour Means	99.7th Percentile of 1-Hour Means	99.9th Percentile of 15-Minute Means
	PC (µg/m³)	PC (µg/m³)	PC (µg/m³)
Maximum predicted	4.9	8.4	12.0
R1. Lighthouse Road	0.54	1.3	2.0
R2. Duffryn High School	0.74	1.8	2.8
R3. Edney Way	0.75	2.1	3.3
R4. Maesglas Crescent	0.77	1.9	3.7
R5. Wolseley Street	0.66	1.9	3.1
R6. St Michael Street	0.35	1.1	2.7
R7. Spytty Lane	0.39	0.89	1.3
R8. New Dairy Farm	1.00	2.5	3.8
R9. Spytty Park	0.36	0.86	1.2
R10. Lysaght	0.53	1.1	1.6
R11. George Street AQMA	0.26	0.86	1.5
AQO (µg/m³)	125	350	266
Background (µg/m³)	15.3	26.0	34.8
Maximum PC as %age of AQO	4.0%	2.4%	4.5%
Maximum PEC as %age of AQO	16.2%	9.8%	17.6%

The contribution from the ERF facility is less than 10% of the AQOs at all locations, therefore the impact is not significant according to the Environment Agency's significance criteria.

5.1.5 Particulate Matter (as PM_{10})

Predicted annual mean and 90.4th percentile of 24-hour mean PM_{10} concentrations at the selected receptor locations are presented in Table 5.4. The predictions assume that 100% of the particulate matter emitted from the facility is PM_{10}. A contour plot of the 90.4th percentile of 24-hour mean PM_{10} concentrations is also presented in Figure 5.3 for the most recent year of meteorological data (2018).

Table 5.4: Predicted PM_{10} Concentrations			
Receptor	Annual Mean		90.4th Percentile of 24-Hour Means
	PC (μg/m³)	PC (%age AQO)	PC (μg/m³)
Maximum predicted	0.13	0.3%	0.39
R1. Lighthouse Road	0.007	0.0%	0.027
R2. Duffryn High School	0.011	0.0%	0.037
R3. Edney Way	0.013	0.0%	0.039
R4. Maesglas Crescent	0.011	0.0%	0.034
R5. Wolseley Street	0.009	0.0%	0.029
R6. St Michael Street	0.005	0.0%	0.015
R7. Spytty Lane	0.006	0.0%	0.019
R8. New Dairy Farm	0.012	0.0%	0.033
R9. Spytty Park	0.008	0.0%	0.025
R10. Lysaght	0.007	0.0%	0.019
R11. George Street AQMA	0.003	0.0%	0.011
AQO (μg/m³)	40		50
Background (μg/m³)	13.0		15.3
Maximum PC as %age of AQO	0.3%		0.8%
Maximum PEC as %age of AQO	32.6%		31.2%

The maximum predicted PM_{10} concentrations are less than 1% and 10% of the relevant long and short-term AQOs respectively and the impacts are assessed as not significant.

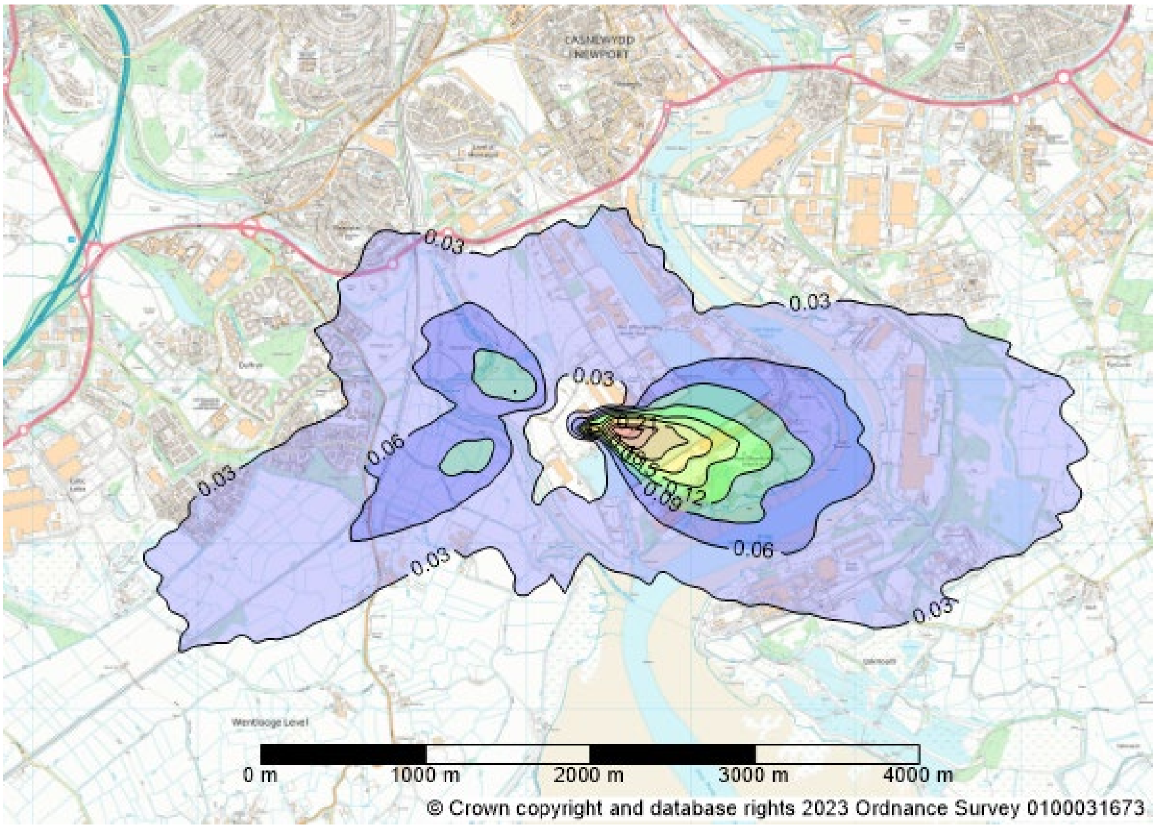

Figure 5.3: Predicted 90.4th Percentile of 24-hour Mean PM_{10} Concentrations (µg/m^3)

5.1.6 Particulate Matter (as $PM_{2.5}$)

Predicted annual mean $PM_{2.5}$ concentrations at the selected receptor locations are presented in Table 5.5. The predictions assume that 100% of the particulate matter emitted from the ERF facility is $PM_{2.5}$. A contour plot of the annual mean $PM_{2.5}$ (and PM_{10}) concentrations is also presented in Figure 5.4 for the most recent year of meteorological data (2018).

Table 5.5: Predicted $PM_{2.5}$ Concentrations		
Receptor	Annual Mean	
	PC (µg/m³)	PC (%age of AQO)
Maximum predicted	0.13	0.7%
R1. Lighthouse Road	0.007	0.0%
R2. Duffryn High School	0.011	0.1%
R3. Edney Way	0.013	0.1%
R4. Maesglas Crescent	0.011	0.1%
R5. Wolseley Street	0.009	0.0%
R6. St Michael Street	0.005	0.0%
R7. Spytty Lane	0.006	0.0%
R8. New Dairy Farm	0.012	0.1%
R9. Spytty Park	0.008	0.0%
R10. Lysaght	0.007	0.0%
R11. George Street AQMA	0.003	0.0%
Limit Value (µg/m³)	20	
Background (µg/m³)	8.2	
Maximum PC as %age of AQO	0.7%	
Maximum PEC as %age of AQO	41.2%	

The maximum predicted annual mean $PM_{2.5}$ concentration is less than 1% of the EU limit value and therefore assessed as not significant.

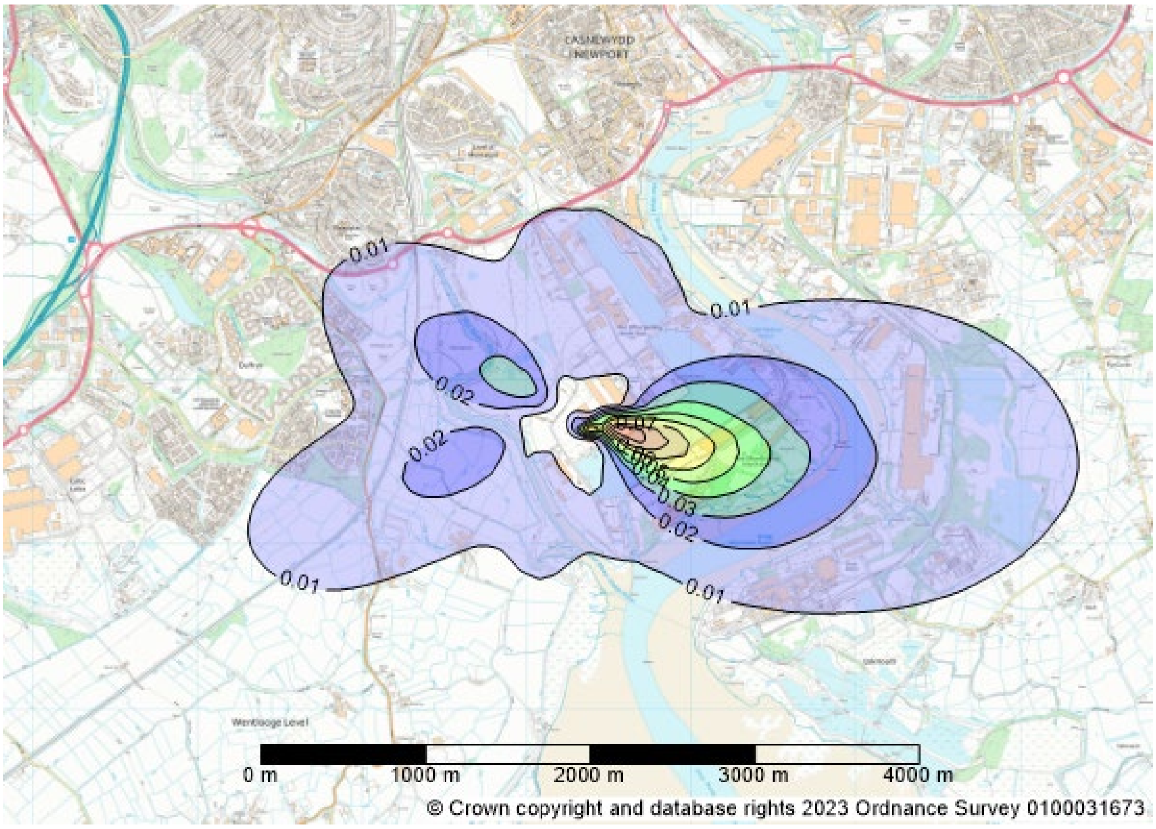

Figure 5.4: Predicted Annual Mean $PM_{2.5}$ and PM_{10} Concentrations (µg/m^3)

5.1.7 Total Organic Carbon (as Benzene)

Predicted annual mean and maximum 24 hour mean ground-level benzene concentrations are presented in Table 5.6.

Table 5.6: Predicted Benzene Concentrations			
Receptor	Annual Mean		Maximum 24 Hour Mean
	PC (µg/m³)	PC (%age of AQO)	PC (µg/m³)
Maximum predicted	0.26	5.3%	1.9
R1. Lighthouse Road	0.015	0.3%	0.27
R2. Duffryn High School	0.022	0.4%	0.36
R3. Edney Way	0.025	0.5%	0.41
R4. Maesglas Crescent	0.022	0.4%	0.29
R5. Wolseley Street	0.017	0.3%	0.28
R6. St Michael Street	0.009	0.2%	0.14
R7. Spytty Lane	0.012	0.2%	0.16
R8. New Dairy Farm	0.023	0.5%	0.41
R9. Spytty Park	0.015	0.3%	0.17
R10. Lysaght	0.014	0.3%	0.20
R11. George Street AQMA	0.007	0.1%	0.12
Limit Value/EAL (µg/m³)	5		30
Background (µg/m³)	0.35		0.41
Maximum PC as %age of AQO	5.3%		6.3%
Maximum PEC as %age of AQO	12.3%		7.7%

Maximum predicted annual mean ground level benzene concentrations are potentially significant at greater than 1% of the EU Limit as the maximum predicted but the PEC is well below 70% of the limit value and it is concluded that the limit value would not be exceeded. Maximum 24 hour mean concentrations are well below 10% of the EAL and the impact on short term benzene concentrations would be assessed as not significant.

5.1.8 Hydrogen Chloride

The predicted maximum 1-hour mean ground-level hydrogen chloride concentrations at identified sensitive receptor locations are presented in Table 5.7.

Table 5.7: Predicted HCl Concentrations	
Receptor	Maximum 1-Hour Mean
	PC (µg/m^3)
Maximum predicted	2.1
R1. Lighthouse Road	0.32
R2. Duffryn High School	0.53
R3. Edney Way	0.80
R4. Maesglas Crescent	0.85
R5. Wolseley Street	0.75
R6. St Michael Street	0.61
R7. Spytty Lane	0.42
R8. New Dairy Farm	0.64
R9. Spytty Park	0.38
R10. Lysaght	0.34
R11. George Street AQMA	0.50
EPAQS Guideline Value (µg/m^3)	750
Background (µg/m^3)	0.52
Maximum PC as %age of AQO	0.3%
Maximum PEC as %age of AQO	0.4%

The maximum predicted hourly mean concentrations are less than 10% of the EPAQS Guideline Value, therefore HCl emissions from the proposed installation are considered to be not significant.

5.1.9 Hydrogen Fluoride

The predicted maximum annual mean and 1-hour mean ground-level hydrogen fluoride concentrations at identified sensitive receptor locations are presented in Table 5.8.

Table 5.8: Predicted HF Concentrations		
Receptor	Monthly Mean	Maximum 1-Hour Mean
	PC (µg/m^3)	PC (µg/m^3)
Maximum predicted	0.036	0.36
R1. Lighthouse Road	0.0016	0.05
R2. Duffryn High School	0.0042	0.09
R3. Edney Way	0.0060	0.13
R4. Maesglas Crescent	0.0040	0.14
R5. Wolseley Street	0.0026	0.12
R6. St Michael Street	0.0017	0.10
R7. Spytty Lane	0.0014	0.07
R8. New Dairy Farm	0.0018	0.11
R9. Spytty Park	0.0019	0.06
R10. Lysaght	0.0014	0.06
R11. George Street AQMA	0.0012	0.08
EPAQS Guideline Value (µg/m^3)	16	160
Background (µg/m^3)	0.5	1.0
Maximum PC as %age of AQO	0.2%	0.2%
Maximum PEC as %age of AQO	3.4%	0.8%

The maximum predicted HF concentrations are less than 10% of the EPAQS short-term Guideline Values and are therefore considered not significant.

5.1.10 Ammonia

The predicted maximum annual mean and 1-hour mean ground-level ammonia concentrations at identified sensitive receptor locations are presented in Table 5.9.

Table 5.9: Predicted NH_3 Concentrations		
Receptor	Annual Mean	Maximum 1-Hour Mean
	PC (µg/m^3)	PC (µg/m^3)
Maximum predicted	0.26	3.6
R1. Lighthouse Road	0.015	0.53
R2. Duffryn High School	0.022	0.89
R3. Edney Way	0.025	1.3
R4. Maesglas Crescent	0.022	1.4
R5. Wolseley Street	0.017	1.2
R6. St Michael Street	0.009	1.02
R7. Spytty Lane	0.012	0.70
R8. New Dairy Farm	0.023	1.07
R9. Spytty Park	0.015	0.63
R10. Lysaght	0.014	0.57
R11. George Street AQMA	0.007	0.83
EPAQS Guideline Value (µg/m^3)	180	2500
Background (µg/m^3)	4.0	8.0
Maximum PC as %age of AQO	0.1%	0.1%
Maximum PEC as %age of AQO	2.4%	0.5%

The maximum predicted NH_3 concentrations are less than 1% and 10% of the long and short-term EALs respectively and are therefore considered not significant.

5.1.11 Trace Metals

The predicted maximum long and short-term trace metal impacts for emissions at maximum BREF limits for new plant are presented in Tables 5.10 and 5.11, respectively.

For the Step 1 screening it is assumed that the background concentration is equal to the measured concentration at the Pontardaew Brecon Road monitoring site (see Table 4.5) for each metal. For chromium VI, the predicted PC and background concentrations are apportioned 20% of the total chromium concentration.

Table 5.10: Maximum Long-Term Trace Metal Concentrations, Step 1				
Pollutant	EAL (ng/m^3)	PC (% of EAL)	PEC (% of EAL)	Further Assessment Required?
Cd	5	10.6%	16.4%	No
Tl	1,000	0.1%	0.1%	No
Hg	250	0.2%	0.2%	No
Sb	5,000	0.2%	0.2%	No
As	6	11%	27.7%	No
Cr	5,000	0.2%	0.2%	No
Cr (VI) (a)	**0.2**	**793%**	**1043%**	**Yes**
Co	1,000	0.8%	0.8%	No
Cu	10,000	0.1%	0.1%	No
Mn	150	5.3%	7.8%	No
Ni	20	40%	66.7%	No
Pb	250	3.2%	5.5%	No
V	5,000	0.2%	0.2%	No

(a) The predicted and background concentrations are apportioned 20% Cr(VI) in accordance with the Environment Agency's guidance.

Table 5.11: Maximum Short-Term Trace Metal Concentrations, Step 1			
Pollutant	EAL (ng/m^3)	PC (% of EAL)	Further Assessment Required?
Hg	7,500	0.1%	No
Sb	150,000	0.1%	No
As	15,000	0.7%	No
Cr (III)	150,000	0.1%	No
Cu	200,000	0.1%	No
Mn	1500,000	0.1%	No
V	1,000	5.7%	No

For the Group III metals, on the basis of the Step 1 screening advice provided by the Environment Agency, further assessment is required only for long term chromium VI. Emissions of all the remaining trace metals are considered to be not significant or the air quality assessment level unlikely to be exceeded.

The EA guidance note for the assessment of Group III metals provides measured concentrations of emissions of metals from waste Incinerators. In accordance with the guidance note, revised concentrations of chromium VI have been predicted using the maximum measured emission concentration (0.00015 mg/Nm^3). The results are presented in Table 5.12.

Table 5.12: Maximum Long-Term Trace Metal Concentrations – Typical Emissions				
Pollutant	EAL (ng/m^3)	PC (% of EAL)	PEC (% of EAL)	Further Assessment Required?
Cr (VI) (a)	0.2	2.0%	252%	Potentially

(a) The background concentrations is apportioned 20% Cr(VI) in accordance with the Environment Agency's guidance.

For Cr(VI), the PC is above 1% of the EAL. However, this represents worst-case conditions as the maximum predicted anywhere within the model domain, the worst-case meteorological conditions and elevated background concentrations. For sensitive receptors, highest concentrations are predicted at receptor R3. The predicted concentration at this receptor is 0.00038 ng/m^3 (0.2% of the EAL). Therefore, taking into account the assumptions adopted it is concluded that no further assessment is required for Cr(VI).

5.1.12 Dioxins and Furans

The predicted annual mean ground level dioxin and furan concentrations (PC) at identified sensitive receptor locations are presented in Table 5.13.

Table 5.13: Predicted PCDD/Fs Concentrations

Receptor	Annual Mean PC (fg/m^3)
Maximum predicted	1.6
R1. Lighthouse Road	0.09
R2. Duffryn High School	0.13
R3. Edney Way	0.15
R4. Maesglas Crescent	0.13
R5. Wolseley Street	0.10
R6. St Michael Street	0.06
R7. Spytty Lane	0.07
R8. New Dairy Farm	0.14
R9. Spytty Park	0.09
R10. Lysaght	0.08
R11. George Street AQMA	0.04
Background (fg/m^3)	7.3
PC as a %age of background Concentrations	21.7%

There are no assessment criteria for dioxins and furans. Compared with the average background concentration measured at urban monitoring sites in the UK, the predicted impact of the proposed installation represents 21.7% of the background concentration. Furthermore, it should be noted that health impacts from exposure to dioxins and furans can arise via inhalation and ingestion exposure. Therefore, health impacts of the emissions of dioxins and furans and dioxin-like PCBs have also been assessed in the human health risk assessment which has been submitted as part of the permit application.

5.1.13 PAH (as Benzo(a)pyrene)

Predicted annual mean ground-level benzo(a)pyrene concentrations are presented in Table 5.14.

Table 5.14: Predicted Benzo(a)pyrene Concentrations		
Receptor	Annual Mean	
	PC (ng/m^3)	PC (%age of AQO)
Maximum predicted	0.0024	0.2%
R1. Lighthouse Road	0.0001	0.0%
R2. Duffryn High School	0.0002	0.0%
R3. Edney Way	0.0002	0.0%
R4. Maesglas Crescent	0.0002	0.0%
R5. Wolseley Street	0.0002	0.0%
R6. St Michael Street	0.0001	0.0%
R7. Spytty Lane	0.0001	0.0%
R8. New Dairy Farm	0.0002	0.0%
R9. Spytty Park	0.0001	0.0%
R10. Lysaght	0.0001	0.0%
R11. George Street AQMA	0.0001	0.0%
Limit Value (ng/m^3)	1	
Background (ng/m^3)	0.19	
Maximum PC as %age of AQO	0.2%	
Maximum PEC as %age of AQO	19.2%	

Maximum predicted ground level benzo(a)pyrene concentrations are less than 1% of the EU Limit Value at all receptors, therefore the impact is considered to be not significant.

5.1.14 Polychlorinated Biphenyls

The predicted maximum annual and 1-hour mean ground-level PCB concentrations at the identified sensitive receptor locations are presented in Table 5.15.

Table 5.15: Predicted PCB Concentrations			
Receptor	Annual Mean		Maximum 1-Hour Mean
	PC (ng/m^3)	PC (%age EAL)	PC (ng/m^3)
Maximum predicted	<0.0001	0.0%	<0.001
R1. Lighthouse Road	<0.0001	0.0%	<0.001
R2. Duffryn High School	<0.0001	0.0%	<0.001
R3. Edney Way	<0.0001	0.0%	<0.001
R4. Maesglas Crescent	<0.0001	0.0%	<0.001
R5. Wolseley Street	<0.0001	0.0%	<0.001
R6. St Michael Street	<0.0001	0.0%	<0.001
R7. Spytty Lane	<0.0001	0.0%	<0.001
R8. New Dairy Farm	<0.0001	0.0%	<0.001
R9. Spytty Park	<0.0001	0.0%	<0.001
R10. Lysaght	<0.0001	0.0%	<0.001
R11. George Street AQMA	<0.0001	0.0%	<0.001
EAL ($\mu g/m^3$)	200		6,000
Background (ng/m^3)	0.085		0.17
Maximum PC as %age of AQO	<0.1%		<0.1%
Maximum PEC as %age of AQO	<0.1%		<0.1%

The maximum predicted PCB concentrations are less than 1% and 10% of the long and short-term EALs respectively and are therefore considered not significant.

5.2 Habitat Impact

5.2.1 Introduction

An interpretation of the impact of air emissions on habitat sites has been undertaken by Argus Ecology and should be read alongside this section of the report. The Argus Ecology report is provided in Appendix F.

5.2.2 Airborne Concentrations of NOx, NH_3 SO_2 and HF

Predicted maximum ground level concentrations of NOx, NH_3, SO_2 and HF at the identified habitat sites are compared with the relevant critical levels in Tables 5.16 to 5.19. The dispersion model is not able to produce weekly mean concentrations. Therefore, the monthly mean HF concentrations have been compared with the critical level.

Table 5.16: Predicted Maximum NOx Concentrations (µg/m³)				
Habitat Site	Annual Mean		24-Hour Mean	
	PC (µg/m³)	PC (%age CL)	PC (µg/m³)	PC (%age CL)
Severn Estuary SAC	0.47	1.6%	9.6	12.8%
Severn Estuary SPA	0.47	1.6%	9.6	12.8%
Severn Estuary SSSI	0.47	1.6%	9.6	12.8%
River Usk SAC	1.2	4.0%	8.9	11.9%
River Usk SSSI	1.2	4.0%	8.9	11.9%
Gwent Levels SSSI	0.64	2.1%	10.3	13.7%
Newport Wetlands SSSI	0.34	1.1%	2.7	3.5%
Duffryn Pond SINC	0.21	0.7%	3.1	4.1%
Julian's Gout Land SINC	0.60	2.0%	3.3	4.3%
Gwent Wetland Reserve SINC	0.17	0.6%	1.9	2.6%
Marshall's SINC	0.50	1.7%	5.9	7.9%
Afon Ebbw River SINC	0.77	2.6%	13.1	17.5%
Numerous Ancient Woodland	0.39	1.3%	5.9	7.8%
Critical Level (µg/m³)	30		75	

For the European habitat sites, highest NO_x concentrations occur at the River Usk SAC and are 4.0% of the critical level of 30 µg/m³. However, the background annual mean NO_x concentration is 22.63 µg/m³ and the PEC at 23.8 µg/m³ would be 79.4% of the critical level. Therefore, as discussed by Argus Ecology (Appendix F, Section 4.1), annual mean NO_x concentrations have declined since 2005 and it is concluded that it is unlikely that the annual mean critical level would be exceeded either now or in the future.

For the European sites, the predicted 24-hour mean concentrations are slightly in excess of 10% of the critical load. However, given the worst-case assumptions adopted for the assessment (maximum emissions, highest concentration anywhere within the habitat and worst-case meteorological conditions) it is concluded that short-term impacts on the European sites would be not significant. For the Gwent Levels SSSI, the 24-hour mean is 13.7% of the critical level based on worst-case assumptions. However, as discussed by Argus Ecology (Appendix F, Section 4.2), there is no risk of short-term NO_x levels affecting vegetation and habitats at the Gwent Levels SSSI or any other sites considered in the assessment.

For the LWS, predicted NO_x concentrations are well below 100% of the critical level for long-term and short-term concentrations and would be assessed as not significant.

Table 5.17: Predicted Maximum NH_3 Concentrations (µg/m^3)		
Habitat Site	Annual Mean	
	PC (µg/m^3)	PC (%age CL)
Severn Estuary SAC	0.039	1.3%
Severn Estuary SPA	0.039	1.3%
Severn Estuary SSSI	0.039	1.3%
River Usk SAC	0.099	3.3%
River Usk SSSI	0.099	3.3%
Gwent Levels SSSI	0.053	1.8%
Newport Wetlands SSSI	0.028	0.9%
Duffryn Pond SINC	0.017	0.6%
Julian's Gout Land SINC	0.050	1.7%
Gwent Wetland Reserve SINC	0.014	0.5%
Marshall's SINC	0.042	1.4%
Afon Ebbw River SINC	0.064	2.1%
Numerous Ancient Woodland	0.032	3.2%
Critical Level (µg/m^3)	1 - 3	

For ammonia, there are two critical levels depending on the presence of bryophytes and lichens. The Air Pollution Information Service (APIS) indicates that these are not present within the European sites or the two SSSI's and the least stringent critical level of 3 µg/m^3 is adopted for these sites. For the majority of the LWS, habitats present are unlikely to support bryophytes or lichens and the less stringent critical level is also adopted. However, for the ancient woodlands the presence of bryophytes and lichens cannot be ruled out and the more stringent critical level of 1 µg/m^3 has been adopted for the ancient woodland.

For the European sites and SSSI's, the impact of ammonia emissions is assessed as potentially significant as the PC is greater than 1% of the critical level. However, the background NH_3 concentration at these sites is 1.87 µg/m^3 (62% of the less stringent critical level) and the PEC at the Severn Estuary, River Usk, Gwent Levels SSSI and Newport Wetlands SSSI are all less than 70% of the critical level and it is unlikely that it would be exceeded.

At the LWS including the ancient woodland, predicted annual mean concentrations of NH_3 are less than 100% of the critical level and would be assessed as not significant.

Table 5.18: Predicted Maximum SO_2 Concentrations (µg/m³)		
Habitat Site	Annual Mean	
	PC (µg/m³)	PC (%age CL)
Severn Estuary SAC	0.12	0.6%
Severn Estuary SPA	0.12	0.6%
Severn Estuary SSSI	0.12	0.6%
River Usk SAC	0.30	1.5%
River Usk SSSI	0.30	1.5%
Gwent Levels SSSI	0.16	0.8%
Newport Wetlands SSSI	0.08	0.4%
Duffryn Pond SINC	0.05	0.3%
Julian's Gout Land SINC	0.15	0.8%
Gwent Wetland Reserve SINC	0.04	0.2%
Marshall's SINC	0.12	0.6%
Afon Ebbw River SINC	0.19	1.0%
Numerous Ancient Woodland	0.10	1.0%
Critical Level (µg/m³)	10 - 20	

As for SO_2, the least stringent critical level of 20 µg/m³ is adopted for all habitats except for the ancient woodland where the more stringent critical level of 10 µg/m³ is adopted.

For the European sites and SSSI's, the PC is greater than 1.0% of the critical level at the River Usk SSSI and would be assessed as potentially significant. However, the background SO_2 concentration is 4.2 µg/m³ and the PEC would be less than 70% of the critical level (20.8%). Therefore, it is very unlikely that the critical level would be exceeded.

For the LWS and ancient woodland, the PCs are all less than 100% of the critical level. Therefore, it is concluded that the impact of emissions of SO_2 at habitat sites would be not significant.

Table 5.19: Predicted Maximum HF Concentrations (µg/m³)				
Habitat Site	Monthly Mean		24-Hour Mean	
	PC (µg/m³)	PC (%age CL)	PC (µg/m³)	PC (%age CL)
Severn Estuary SAC	0.008	1.6%	0.080	1.6%
Severn Estuary SPA	0.008	1.6%	0.080	1.6%
Severn Estuary SSSI	0.008	1.6%	0.080	1.6%
River Usk SAC	0.018	3.5%	0.075	1.5%
River Usk SSSI	0.018	3.5%	0.075	1.5%
Gwent Levels SSSI	0.012	2.5%	0.086	1.7%
Newport Wetlands SSSI	0.005	1.1%	0.022	0.4%
Duffryn Pond SINC	0.005	1.0%	0.025	0.5%
Julian's Gout Land SINC	0.008	1.5%	0.027	0.5%
Gwent Wetland Reserve SINC	0.003	0.6%	0.016	0.3%
Marshall's SINC	0.013	2.7%	0.049	1.0%
Afon Ebbw River SINC	0.013	2.6%	0.109	2.2%
Numerous Ancient Woodland	0.008	1.7%	0.049	1.0%
Critical Level (µg/m³)	0.5		5	

Predicted 24-hour mean and monthly (weekly) mean concentrations are all less than 10% of the respective critical level and would be assessed as not significant.

5.2.3 Eutrophication

The predicted maximum nutrient nitrogen deposition rate arising from emissions of NOx and NH_3 from the facility are presented in Table 5.20. The process contribution (PC) is compared with the relevant critical load (CL) and combined with the relevant background concentration (refer to **Appendix E**).

Table 5.20: Predicted Eutrophication Rates (kg N/ha/a)				
Habitat Site	PC	Total Deposition (PEC)	Lowest CL	PC (% CL)
Severn Estuary SAC	0.27	15.11	20	1.3%
Severn Estuary SPA	0.27	15.11	20	1.3%
Severn Estuary SSSI	0.27	15.11	20	1.3%
River Usk SAC	0.68	15.52	-	-
River Usk SSSI	0.68	15.52	-	-
Gwent Levels SSSI	0.37	15.21	-	-
Newport Wetlands SSSI	0.20	15.04	15 to 20	1.3% to 1.0%
Duffryn Pond SINC	0.12	17.01	15	0.8%
Julian's Gout Land SINC	0.35	15.19	20	1.7%
Gwent Wetland Reserve SINC	0.10	14.94	20	0.5%
Marshall's SINC	0.29	17.85	20	1.4%

Afon Ebbw River SINC	0.44	18.00	20	2.2%
Numerous Ancient Woodland	0.36	29.93	10	3.6%

For the Severn Estuary, the predicted nutrient nitrogen deposition rate exceeds 1% of the critical load and is potentially significant. Furthermore, the PEC at this site also exceeds 70% of the critical load and further ecological interpretation is required. However, as discussed by Argus Ecology (Appendix F, Section 4.3), it is considered that there is sufficient headroom between the PEC and the critical load for these habitats such that the critical load would unlikely be exceeded in the future.

For Newport Wetlands SSSI, there is a small exceedance of the critical load (water rail/rich fen habitat), the PC is 1.3% of the critical load and the PEC is 100%. However, as discussed by Argus Ecology (Appendix F, Section 3.6), the water rail at this site appear to be primarily associated with less sensitive reedbed habitats, and there does not seem to be a clear conceptual effect pathway whereby effects on rich fen supporting habitat would negatively affect this species. For the saltmarsh habitats, the PC is 1.0% of the critical load.

For the River Usk, catchment scale effects of nitrogen deposition in the River Usk are discussed in *Section 5.2.5*.

The maximum PC nutrient nitrogen deposition rate arising from the facility is less than 100% of the critical load for the LWS and ancient woodland and would be assessed as not significant.

5.2.4 Acidification

Predicted maximum acid deposition rates predicted over the five years of meteorological data are presented in Table 5.21 for the habitat sites and include the contribution from nitrogen and sulphur. The contribution from HCl has been included with 50% assigned to sulphur and 50% to nitrogen. The process contributions (PC) are compared with the relevant critical loads provided in Appendix E. The percentage of the critical load has been calculated using the Critical Function Tool on the APIS website.

Table 5.21: Predicted Acid Deposition Rates (keq/ha/yr)				
Habitat Site	PC (N)	PC (S)	PC (% CL)	PEC (% CL)
Severn Estuary SAC	0.020	0.014	Not sensitive	
Severn Estuary SPA	0.020	0.014	Not sensitive	
Severn Estuary SSSI	0.020	0.014	3.2% - 0.7%	110% - 26%
River Usk SAC	0.050	0.036	Not sensitive	
River Usk SSSI	0.050	0.036	Not provided	
Gwent Levels SSSI	0.027	0.019	Not sensitive	
Newport Wetlands SSSI	0.014	0.010	0.5%	26%
Duffryn Pond SINC	0.009	0.006	0.3%	26%
Julian's Gout Land SINC	0.025	0.018	0.9%	23%
Gwent Wetland Reserve SINC	0.007	0.005	Not sensitive	
Marshall's SINC	0.021	0.015	0.7%	28%
Afon Ebbw River SINC	0.032	0.023	1.1%	29%
Numerous Ancient Woodland	0.027	0.024	0.4%	20%

At the Severn Estuary SSSI, predicted concentrations exceed the 1% criterion for acid grassland habitats but as discussed by Argus Ecology (Appendix F, Section 4.4), this is not appropriate in what are likely to be well-buffered soils. For calcareous grassland broad habitat, the PC is well below 1% and the PEC remains well below the critical load.

The maximum PC acidification rate arising from the facility is less than 100% of the critical load for the LWS and ancient woodland and would be assessed as not significant.

5.2.5 Total Deposition of Nitrogen to the River Usk Catchment

As discussed by Argus Ecology in Appendix F (Section 4.5), it is important to compare the contribution of the facility to nutrient nitrogen deposition against other potentially more significant sources such as direct discharges to water. Therefore, the model has been used to determine the contribution from airborne NOx to the River Usk catchment. An extensive area of the catchment was included in the model, extending 31 km to the north of the site and an area of 51,906 hectares. The average nutrient nitrogen deposition for NOx and NH_3 was 0.0042 and 0.013 kgN/ha/a, respectively. Assuming 50% of the nitrogen deposited to the catchment area runoffs to the river habitat then this would result in the total addition of 438 kgN/a to the River Usk (109 kgN/a from NO_x and 329 kgN/a from NH_3). For 10% runoff, this would result in an additional 87.6 kgN/a to the River Usk (21.8 kgN/a from NO_x and 65.7 kgN/a from NH_3).

Argus Ecology (Appendix F, Section 4.5) conclude that the predicted nitrogen input to the catchment is extremely low as a proportion of baseline values. In addition, although reduction of nutrient nitrogen in rivers is clearly a desirable aim, the focus in the River Usk SAC and SSSI is on reducing phosphate levels as providing the greatest ecological benefit, as the main river is considered to be phosphorus-limited. Therefore, the impact of nitrogen deposition to the Usk catchment can be regarded as inconsequential, with no risk of a likely significant effect.

5.3 Emissions at Half-hourly ELVs

The dispersion modelling results presented Section 5.1 have been predicted assuming that the installation is operating for all hours in the year with the pollutant concentrations exactly at the daily emission limit value prescribed by the IED or BREF. This is an extreme assumption, especially for the annual average concentrations, since the facility could never operate with release rates as high as this in practice and remain compliant with legislation.

Short term peak concentrations may arise if the facility emits pollutants at levels approaching the half hourly IED limit values. These pollutants are particulate matter, nitrogen dioxide, sulphur dioxide, hydrogen chloride, hydrogen fluoride and carbon monoxide and have the following half-hourly emission limit values:

- total dust – 30 mg Nm^{-3} (10 mg Nm^{-3} 97% compliance);
- hydrogen chloride – 60 mg Nm^{-3} (10 mg Nm^{-3} 97% compliance);
- hydrogen fluoride – 4 mg Nm^{-3} (2 mg Nm^{-3} 97% compliance);
- sulphur dioxide – 200 mg Nm^{-3} (50 mg Nm^{-3} 97% compliance);
- oxides of nitrogen – 400 mg Nm^{-3} (200 mg Nm^{-3} 97% compliance); and
- carbon monoxide – 100 mg m^{-3}.

Such excursions above daily limit values are permitted for only 3% of a year. The probability of such occasions occurring at the same time as the meteorological conditions that produce the highest one hour mean ground level concentrations is unlikely. On the basis of these worst-case assumptions, maximum predicted short-term concentrations for emissions at the half hourly limit values are provided in Table 5.22. It should be noted that these results represent an extreme worst-case and for some of the pollutants (NO_2, SO_2 and PM_{10}) there are a number of occasions when the AQO can be exceeded.

Table 5.22: Maximum Predicted Short-term Concentrations at the Half-hourly ELVs

Pollutant	PC (µg/m³)	PC (%)
NO_2 (maximum 1-hour)	49.8	24.9%
SO_2 (maximum 15-minute)	95.3	35.8%
SO_2 (maximum 1-hour)	71.1	20.3%
SO_2 (maximum 24-hour)	37.7	30.2%
PM_{10} (maximum 24-hour)	5.7	11.3%
HCl (maximum 1-hour)	21.3	2.8%
HF (maximum 1-hour)	1.42	0.9%
CO (maximum 8-hour)	24.3	0.2%
CO (maximum 1-hour)	35.5	0.1%

Predicted concentrations are between 0.1% and 35.8% of the short term AQO. Highest concentrations relative to the AQO are predicted for SO_2 (as the maximum 15-minute mean). On the basis of these worst-case results, it is very unlikely that the AQO would be exceeded. Therefore, it is concluded that emissions at the half hourly limits would not have a significant impact on air quality even assuming worst case dispersion conditions occurring during periods of elevated emissions.

5.4 Abnormal Emissions

5.4.1 Introduction

Initial results are based on normal operating conditions and using daily emission limits where daily and half hourly values are provided. Article 46 of the Industrial Emissions Directive (IED) allows abnormal operation, where emission limit values can be exceeded for certain periods, without being in contravention of the Environmental Permit for the plant. This assessment identifies foreseeable events at the plant which constitute abnormal operations, which may have an impact on the subsequent emissions to air. The assessment then goes on to quantify the impacts to air quality in the vicinity of the plant as a result of these changes in emissions. The assessment focuses on the potential changes in emissions arising from failure of abatement plant, and mechanical failure.

5.4.2 Overview of Abnormal Emissions

In the event of any process upset or mechanical failure the immediate action to implement process controls, which ensure that standby equipment, where available and associated abatement systems are operational. In addition, various actions and monitoring procedures will be initiated by the Operator to ensure that the plant combustion parameters and emissions remain within the Environmental Permit, thereby avoiding an abnormal operation where possible. If any process upset or mechanical failure results in a significant change to the emission conditions or process that cannot be easily and quickly remedied, the primary response from the operator will be to reduce load or initiate a controlled shutdown of the plant as appropriate.

Abnormal operation is not applicable to high CO or total organic carbon (TOC) emissions; in the event of emission levels of either being above the Emission Limit Value (ELV) the plant load would be reduced and a controlled shutdown initiated. Therefore, it is considered that periods where the plant continues to operate for extended periods with CO or TOC above the ELV would not occur.

5.4.3 Approach

The abnormal modelling approach has considered the short-term impacts during periods of abnormal operation, assuming a worst case of complete abatement failure. A series of factors have been derived in order to ascertain the likely increases in emissions that may occur for each pollutant due to various foreseeable abnormal operations. For particulate matter, CO, and TOC the limits in Annex VI, Part 3 of the IED were used for this assessment.

The dispersion modelling approach used to assess impacts under normal operating conditions uses daily emission limits to predict short term ground level pollutant concentrations. These predictions are then compared to the relevant air quality standard. For the assessment of abnormal emissions, the impact on short term concentrations is of more importance since occasional excursions above the ELV would have negligible impact on long term air quality impacts. However, the Environment Agency has requested that the long-term impact of abnormal conditions is considered for some pollutants namely dioxins and furans, mercury and PCBs. It should be noted that mercury is unlikely to be present in the waste treated and emissions of mercury to atmosphere are likely to be well below the ELV.

5.4.4 Abnormal Emissions – Short-term Impacts

Article 46(6) of the IED states that 'under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limits values are exceeded'. In addition, Article 46(6) also states that 'the cumulative duration of operation in such conditions over one year shall not exceed 60 hours'. Therefore, in order to assess the short-term ground level conditions that would result from the facility operating at a plausible abnormal operational emission level for four hours, the assessment has considered the short-term ground level concentrations where emissions occur at above half-hourly emission limits. The short-term emissions that are assumed to occur during abnormal conditions are presented in Table 5.23.

Table 5.23: Short-term Abnormal Emission Concentrations – Non-metals

Pollutant	Half-hour ELV (mg/Nm^3)	Daily ELV (mg/Nm^3)	Plausible Abnormal Emission (mg/Nm^3)(a)	Plausible Abnormal Emission (g/s)
NOx	400	120	400 (b)	20.4
SO_2	200	30	767 (15-minute) (b) 767 (hourly) (b) 153 (daily) (c)	39.1 39.1 7.78
Total dust (PM_{10})	30	5	29.2 (d)(e)	1.49
HCl	60	6	977 (b)	49.7
HF	4	1	163 (f)	8.29
CO	100	50	75 (8-hourly) (g) 100 (hourly)	3.82 5.09
PCBs	-	3.6×10^{-9} (h)	3.6×10^{-7} (i)	1.83×10^{-8}

(a) Abnormal emissions assumed to occur for 4 hours, for the remainder of the averaging period (e.g. for emissions with 24-hour or 8-hour AQO) emissions are assumed to be at the daily ELV
(b) Provided by the operator
(c) Calculated as 4 hours at 767 mg/Nm^3 and 20 hours at 30 mg/Nm^3
(d) The maximum total dust emission is restricted to 150 mg/Nm^3 (Annex VI, Part 3(2) of the IED)
(e) Calculated as 4 hours at 150 mg/Nm^3 and 20 hours at 5 mg/Nm^3
(f) Assumed to be the same ratio of normal to abnormal emissions as HCl (i.e. 977 *1/6)
(g) Calculated as 4 hours at 100 mg/Nm^3 and 4 hours at 50 mg/Nm^3, half hour emission limit not to be exceeded
(h) Assumed emission concentration in the absence of an emission limit and as assumed for normal emissions
(i) Assumed to increase by a factor of 100

For metals other than mercury, it is assumed that metals are associated with the particle phase and that the emission will increase at the same rate as the total dust emission (i.e. by a factor of 30 = 150/5). For mercury, it is assumed that the abnormal emission concentration is 100 times the emission limit. Therefore, short-term emission concentrations for trace metals would be as follows:

- 0.6 mg/Nm^3 (0.031 g/s) for thallium;
- 2 mg/Nm^3 (0.10 g/s) for mercury;
- 9 mg/Nm^3 (0.46 g/s) for antimony, arsenic, chromium, cobalt and manganese with hourly EALs; and
- 1.75 mg/Nm^3 (0.089 g/s) for vanadium which has a 24 hour EAL (4 hours at 9 mg/Nm3 and 20 hours at 0.3 mg/Nm^3).

5.4.5 Abnormal Emissions – Long-term Impacts

For assessing abnormal emissions on long-term concentrations of mercury, dioxins and furans and PCBs, it is assumed that complete failure of the abatement equipment occurs for the full 60 hours allowed per annum and that emissions are 100 times the limit for all of these 60 hours. There is no air quality objective (AQO) or environmental assessment level (EAL) for dioxins/furans. Therefore, the human health risk assessment has been updated to take account of abnormal dioxin/furan concentrations and it is not considered further here. Assuming that the plant operates at the emission limit (or assumed emission concentration) for 8,700 hours and at 100 times the limit for 60 hours of the year, the emission concentrations for PCBs and mercury would be 6.04 x 10^{-9} mg/Nm^3 (3.1 x 10^{-10} g/s) and 0.034 mg/Nm^3 (0.00171 g/s), respectively.

5.4.6 Results – Short-term Impacts

Maximum predicted concentrations are provided for the relevant averaging period assuming that abnormal emissions occur during the period of worst-case dispersion conditions for the five years of meteorological data in Table 5.24. Exceedance of the limit value does not necessarily indicate non-compliance with the AQO as some of the pollutants considered (e.g. NO_2, SO_2 and PM_{10}) have AQO where a number of exceedances are allowed. The predicted ground level concentrations have been determined assuming that operating conditions, such as volumetric flow and temperature, remain the same.

Table 5.24: Maximum Predicted Short-term Concentrations for Abnormal Emissions		
Pollutant	PC (µg/m³)	PC (%)
NO_2 (maximum 1-hour)	49.8	24.9%
SO_2 (maximum 15-minute)	365.4	137.4%
SO_2 (maximum 1-hour)	272.7	77.9%
SO_2 (maximum 24-hour)	28.8	23.1%
PM_{10} (maximum 24-hour)	5.5	11.0%
HCl (maximum 1-hour)	347.3	46.3%
HF (maximum 1-hour)	57.9	36.2%
CO (maximum 8-hour)	18.2	0.2%
CO (maximum 1-hour)	35.5	0.1%
Pollutant	PC (ng/m³)	PC (%)
Thallium (maximum 1-hour)	213	0.7%
Mercury (maximum 1-hour)	711	9.5%
Antimony (maximum 1-hour)	3199	2.1%
Arsenic (maximum 1-hour)	3199	21.3%
Chromium (maximum 1-hour)	3199	2.1%
Cobalt (maximum 1-hour)	3199	10.7%
Copper (maximum 1-hour)	3199	1.6%
Manganese (maximum 1-hour)	3199	2.1%
Vanadium (maximum 24-hour)	330	33.0%
PCBs (maximum 1-hour)	0.000128	0.0%

Emissions at the abnormal emission concentrations even for the worst-case assumptions adopted are less than 100% of the AQO except for 15-minute SO_2. Therefore, an exceedance is unlikely even for worst-case meteorological conditions. For SO_2, the maximum predicted 15-minute concentration is 137% of the AQO of 266 µg/m³ and the 99.9th %ile of 15-minute mean concentrations is 306.6 µg/m³ (115% of the AQO). There is a risk that the AQO could be exceeded. However, there are no sensitive receptors at the location of the maximum predicted impact. For the worst-case receptor (R8), the 99.9th percentile of 15-minute means would be 97.1 µg/m³ (36.5% of the AQO). Therefore, it is concluded that abnormal emissions would not result in short-term adverse impacts.

5.4.7 Results – Long-term Impacts

The long-term impact of abnormal emissions of mercury and PCBs is summarised in Table 5.25. Predicted concentrations are provided for the worst-case meteorological year. The predicted ground level concentrations have been determined assuming that operating conditions, such as volumetric flow and temperature, remain the same. Predicted concentrations are less than 1% of the relevant EALs and would be assessed as not significant.

Table 5.25: Predicted Annual Mean Concentrations for Abnormal Emissions		
Pollutant	PC (ng/m^3)	PC (%)
Mercury	0.89	0.4%
PCBs	1.6×10^{-7}	<0.1%

5.5 Sensitivity Analysis

5.5.1 Introduction

For the detailed assessment provided, a conservative approach has been undertaken in order to avoid underestimating the impact of the installation on local air quality. This has included emissions at the maximum permissible, the worst-case meteorological year for each averaging period and continuous operation of the installation at full load. The effect of varying some of these parameters is considered. This sensitivity analysis has been carried out for emissions of NOx as this is considered to be the key pollutant emitted from the installation. Predicted concentrations of NO_2 are provided as the maximum predicted for the annual mean and the 99.8th percentile of hourly means.

5.5.2 Meteorological Data

Dispersion modelling for five years of meteorological data for Rhoose meteorological observing station was undertaken. Results presented in Section 5.1 are the highest predicted for each averaging period. A comparison of predicted concentrations of NO_2 for each of the five years is presented in Table 5.26 as the maximum predicted anywhere within the modelling domain.

Table 5.26: Maximum Predicted Concentrations of NO_2 for Annual Meteorological Data Sets				
Year	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg/m^3)	PC (%age AQO)		PC (ug/m^3)
2014 Rhoose	1.3	3.3%	11.6	5.8%
2015 Rhoose	1.6	4.0%	11.9	5.9%
2016 Rhoose	1.6	4.1%	11.7	5.9%
2017 Rhoose	2.2	5.6%	11.9	5.9%
2018 Rhoose	1.7	4.2%	11.9	6.0%
Average	1.7	4.2%	11.8	5.9%

For the annual mean, predicted concentrations for the five years are quite variable with the lowest concentration (2014) being 59% of the highest concentration (2017). The average for the five years is 1.7 µg/m^3 (77% of the maximum year). The hourly mean concentrations are more comparable with the highest concentration (2015, 2017 and 2018) 103% of the lowest concentration (2014).

5.5.3 *Building Height*

The assessment provided assumes that the main building is the maximum at the building apex (39 m). Modelling the building with the mean of the eaves and apex (37.6 m) is presented in Table 5.27.

Table 5.27: Predicted Maximum NO_2 Concentrations for Variable Main Building Height

Year	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg/m³)	PC (%age AQO)		PC (ug/m³)
2017 maximum height of 39 m	2.2	5.6%	11.9	5.9%
2017 mean height of 37.6 m	1.9	4.9%	10.6	5.3%

The use of the mean building height in the model results in a decrease for annual mean concentrations (0.7% of the AQO) and a decrease for the short-term concentration (0.6% of the AQO). For both averaging periods, the impact would be assessed as not significant for the smaller building.

5.5.4 *Surface Roughness*

The assessment provided assumes that the surface roughness surrounding the facility is 0.3 m mainly due to the open areas of land to the north, west and east. However, the port area to the east is dominated by buildings and the effect of modelling at a higher surface roughness of 0.5 m has been assessed. Results for both surface roughness values are provided in Table 5.28.

Table 5.28: Predicted Maximum NO_2 Concentrations for Variable Surface Roughness Values

Year	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg/m³)	PC (%age AQO)		PC (ug/m³)
2017 surface roughness of 0.3 m	2.2	5.6%	11.9	5.9%
2017 surface roughness of 0.5 m	2.0	5.0%	12.4	6.2%

The use of the higher surface roughness in the model results in a small decrease in annual mean concentrations and a small decrease for the short-term concentration. For both averaging periods, the impact would be assessed as not significant or the air quality objective unlikely to be exceeded for the higher surface roughness.

5.5.5 *Summary*

The sensitivity analysis has demonstrated that varying the assumptions made for the assessment does not significantly vary the predicted concentrations for most choices. Therefore, it is concluded that overall the assessment provided is robust and representative of worst-case conditions.

6. CONCLUSIONS

An assessment has been carried out to determine the local air quality impacts associated with emissions from the proposed installation.

Detailed air quality modelling using the AERMOD 10 dispersion model has been undertaken to predict the impacts associated with stack emissions from the facility.

The maximum impact of pollutant emissions from the site is considered not significant on the basis of the Environment Agency criteria and professional judgement taking into account the worst-case assumptions that have been adopted for the assessment.

The impact of emissions from the proposed facility on habitat sites was also assessed. It was concluded that no likely significant effects are predicted on qualifying features of the European habitat sites, and no significant harm is predicted for notified features of the nationally designated Sites of Special Scientific Interest.

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Appendix A – Air Quality Terminology

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
Defra	Department for Environment, Food and Rural Affairs.
Exceedance	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO_2	Nitrogen dioxide.
NO_x	Nitrogen oxides.
O_3	Ozone.
Percentile	The percentage of results below a given value.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
ppb parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10^9) units of air, there is one unit of pollutant present.
ppm parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10^6) units of air, there is one unit of pollutant present.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
$\mu g/m^3$ micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1ug/m3 means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.

Term	Definition
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

Appendix B – Air Quality Standards and Objectives

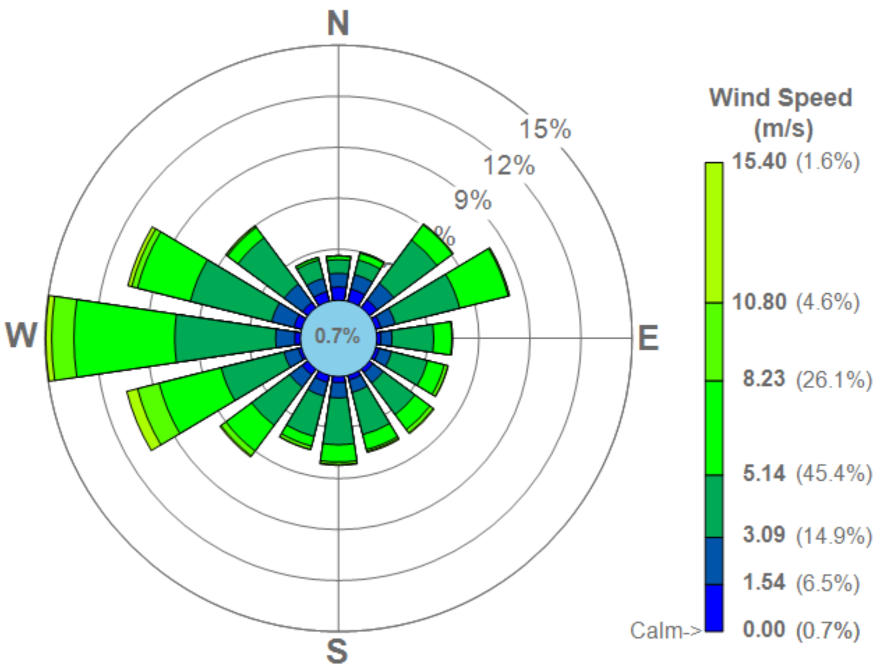
Pollutant	Averaging Period	EAL / AQS (µg/m³)	Comments
Nitrogen dioxide (NO_2)	annual	40	UK AQO
	1-hour	200	UK AQO, not to be exceeded more than 18 times per annum, equivalent to the 99.8th percentile of 1-hour means
Sulphur dioxide (SO_2)	24-hour	125	UK AQO, not to be exceeded more than 3 times per annum, equivalent to the 99.2nd percentile of 24-hour means
	1-hour	350	UK AQO, not to be exceeded more than 24 times per annum, equivalent to the 99.7th percentile of 1-hour means
	15-minute	266	UK AQO, not to be exceeded more than 35 times per annum, equivalent to the 99.9th percentile of 15-minute means
Carbon monoxide (CO)	8-hour	10,000	UK AQO
	1-hour	30,000	Short-term EAL
Particulate matter (as PM_{10})	annual	40	UK AQO
	24-hour	50	UK AQO, not to be exceeded more than 35 times per annum, equivalent to the 90.4th percentile of 24-hour means
Particulate matter (as $PM_{2.5}$)	annual	20	EU Target Value
Benzene	annual	5	EU Limit Value
	24-hour	30	EAL
Hydrogen Chloride (HCl)	1-hour	750	EPAQS Guideline Value
Hydrogen Fluoride (HF)	Monthly	16	EPAQS Guideline Value
	1-hour	160	EPAQS Guideline Value
Ammonia (NH_3)	Annual	180	EAL derived from long-term occupational exposure limits
	1-hour	2,500	EAL derived from long-term occupational exposure limits as no short-term limit exists
Antimony (Sb)	annual	5	EAL derived from long-term occupational exposure limits
	1-hour	150	EAL derived from long-term occupational exposure limits as no short-term limit exists
Arsenic (As)	annual	0.006	EU Target Value
	1-hour	15	EAL

Cadmium (Cd)	annual	0.005	WHO Guideline Value
Chromium III (CrIII)	annual	5	EAL derived from long-term occupational exposure limits
	1-hour	150	EAL derived from long-term occupational exposure limits as no short-term limit exists
Chromium VI (CrVI)	annual	0.0002	EPAQS Guideline Value
Cobolt (Co)	annual	1	EAL derived from long-term occupational exposure limits
Copper (Cu)	Annual	10	Copper as dusts and mists. EAL derived from long-term occupational exposure limits
	1-hour	100	EAL derived from short-term occupational exposure limits
Manganese (Mn)	Annual	0.15	WHO Guideline Value
	1-hour	1,500	EAL derived from long-term occupational exposure limits as no short-term limit exists
Lead (Pb)	1-hour	0.25	UK AQO
Mercury (Hg)	annual	0.25	EAL derived from long-term occupational exposure limits
	1-hour	7.5	EAL derived from long-term occupational exposure limits as no short-term limit exists
Nickel (Ni)	annual	0.02	EPAQS Guideline Value
Thallium(Tl)	annual	1	EAL derived from long-term occupational exposure limits
Vanadium (V)	annual	5	EAL derived from long-term occupational exposure limits
	24-hour	1	WHO Guideline Value
Polycyclic Aromatic Hydrocarbons (PAH) as Benzo(a)Pyrene	annual	0.001	EU Limit Value
Polychlorinated Biphenyls (PCBs)	annual	0.2	EAL derived from long-term occupational exposure limits
	1-hour	6	EAL derived from long-term occupational exposure limits as no short-term limit exists

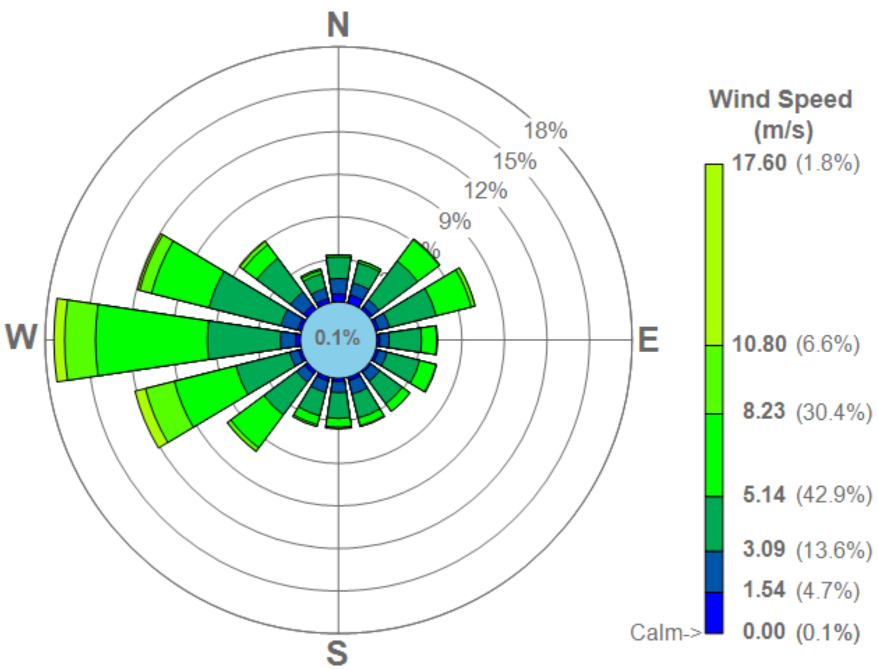
Appendix C – Dispersion Model Input Parameters

Table C1: Emission Parameters for the Energy Recovery Facility	
Parameter	Emission Parameters
Temperature (°C)	148
Actual flow rate (Am3/s)	71.3
Oxygen content (%v/v dry)	8.0
Moisture content (%v/v)	15.5
Normalised Flow Rate (Nm^3/s)	50.9 (a)
Emission Concentration (mg/Nm^3) (a)	
PM_{10}	5
TOC	10
HCl	6
HF	1
CO	50
SOx	30
NOx	120
Dioxins and Furans	6×10^{-8}
Group I (Cd, Tl)	0.02
Group II (Hg)	0.02
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.3
NH_3	10
PAH (as Benzo(a)pyrene)	9.0×10^{-5}
PCBs	3.6×10^{-9}
(a) At 11% O_2, 273.15K, 101.3 mb, dry	

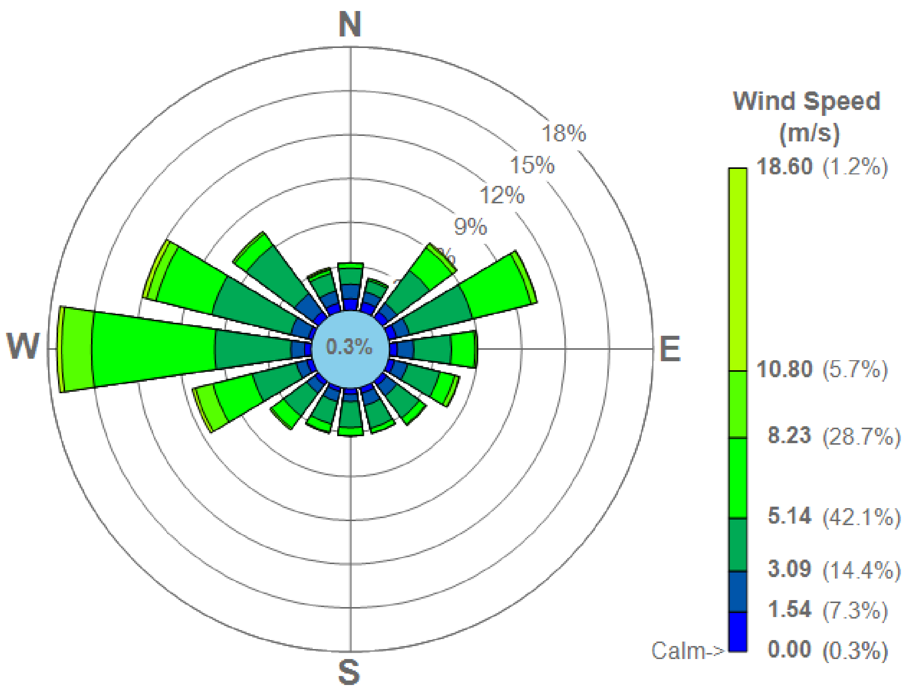
Appendix D – Wind Roses for Cardiff Airport (Rhoose)



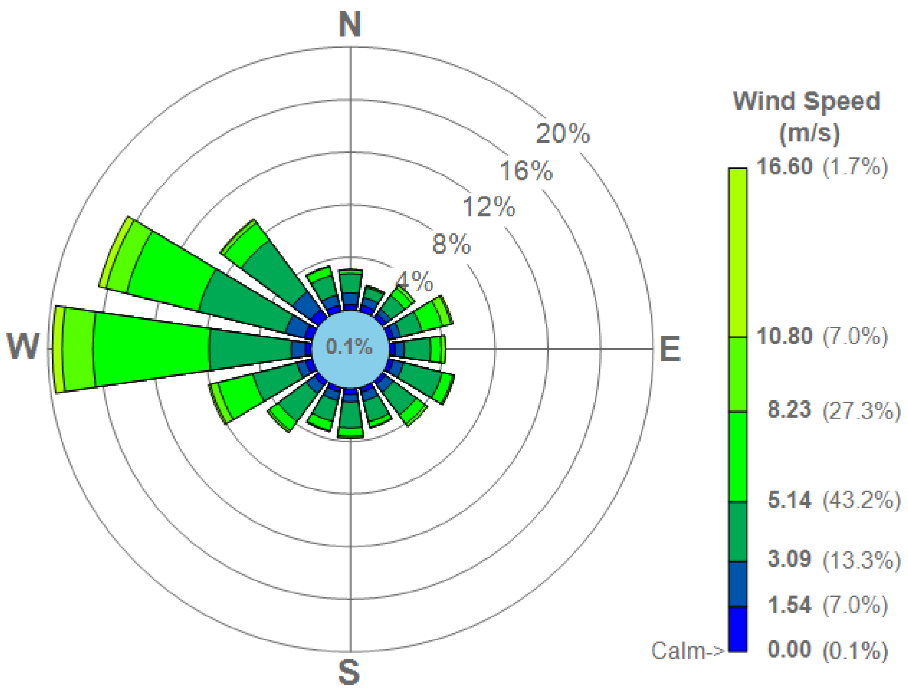
2014



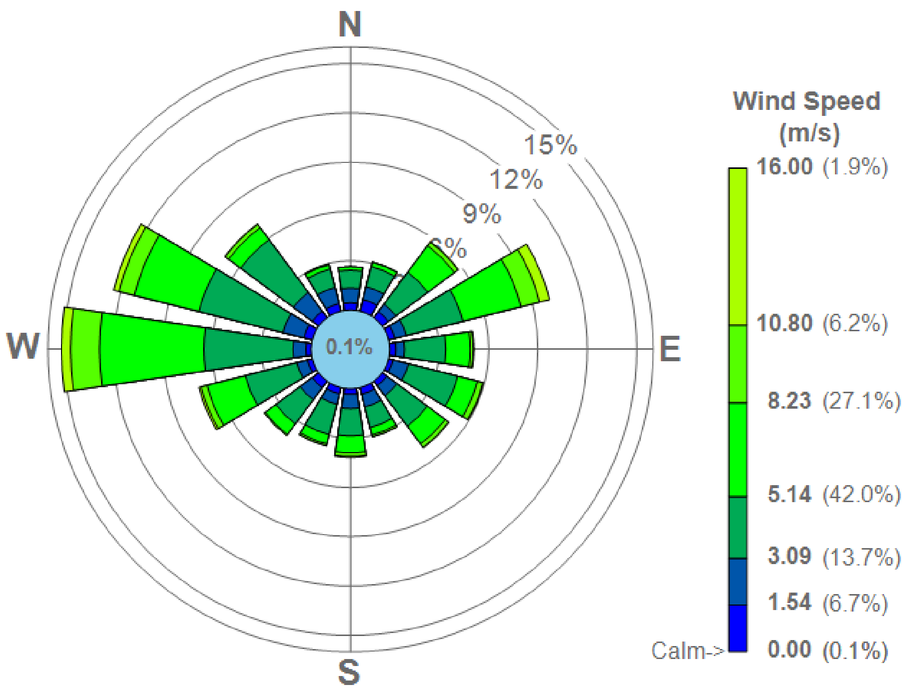
2015


N
E
S
W
18%
15%
12%
9%
0.3%
Wind Speed (m/s)
18.60 (1.2%)
10.80 (5.7%)
8.23 (28.7%)
5.14 (42.1%)
3.09 (14.4%)
1.54 (7.3%)
Calm-> 0.00 (0.3%)

2016


N
E
S
W
20%
16%
12%
8%
4%
0.1%
Wind Speed (m/s)
16.60 (1.7%)
10.80 (7.0%)
8.23 (27.3%)
5.14 (43.2%)
3.09 (13.3%)
1.54 (7.0%)
Calm-> 0.00 (0.1%)

2017


N
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15%
12%
9%
6%
0.1%
Wind Speed (m/s)
16.00 (1.9%)
10.80 (6.2%)
8.23 (27.1%)
5.14 (42.0%)
3.09 (13.7%)
1.54 (6.7%)
Calm->
0.00 (0.1%)

2018

Appendix E – Environmental Assessment Levels for the Protection of Vegetation and Ecosystems

Critical Levels

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals.

The critical levels for the protection of vegetation and ecosystems (as defined by the EU Directive 2008/50/EC and the 2010 UK Air Quality Standards Regulations) that are relevant to the assessment are summarised in Table E1.

Table E1: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Averaging Period	Concentration (µg/m^3)
Oxides of Nitrogen (NOx)	Annual Mean	30
	24-Hour Mean	75
Ammonia (NH_3)	Annual mean	1 to 3
Sulphur Dioxide (SO_2)	Annual Mean / Winter Mean (31 Oct to 1 Mar)	10 to 20
Hydrogen Fluoride (HF)	Weekly Mean	0.5
	Daily Mean	5

Background NO_x, NH_3 and SO_2 concentrations for the habitat sites, as obtained from APIS, are presented in Table E2 for each site. For NH_3, the 2018 mid year has been used due to a current error in background ammonia concentrations in the APIS data set.

Table E3: Background Concentrations of NO_x, NH_3 and SO_2			
Habitat Site	Annual Mean NO_x	Annual Mean NH_3	Annual Mean SO_2
Severn Estuary SAC	12.23	1.87	1.71
Severn Estuary SPA	12.23	1.87	1.71
Severn Estuary SSSI	12.23	1.87	1.71
River Usk SAC	22.63	1.87	3.86
River Usk SSSI	22.63	1.87	3.86
Gwent Levels SSSI	15.92	1.87	1.95
Newport Wetlands SSSI	11.55	1.87	1.52
Duffryn Pond SINC	15.35	2.13	1.39
Julian's Gout Land SINC	16.07	1.87	1.28
Gwent Wetland Reserve SINC	12.23	1.87	1.71
Marshall's SINC	23.4	2.11	2.38
Afon Ebbw River SINC	19.6	2.11	2.38
Numerous Ancient Woodland	15.35	2.13	1.39

Critical Loads

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. This takes the form of either gravitational settling of particulate matter (dry deposition) or wet deposition, where atmospheric pollutants dissolve in water vapour and then precipitate to the ground (e.g. as rain, snow, fog etc.).

Critical loads for eutrophication (nutrient nitrogen deposition) and background nutrient nitrogen deposition rates have been obtained from APIS and are summarised in Table E3 for the identified habitat sites. The background deposition rates are the 2018 mid-year due to errors in NH_3 concentrations which also affect the nutrient nitrogen deposition.

Table E3: Critical Loads for Eutrophication			
Habitat Site	Critical Load Class	Critical Load (kg N/ha/a)	Background N Deposition (kg N/ha/a)
Severn Estuary SAC	Pioneer, low-mid-upper saltmarshes	20 - 30	14.84
Severn Estuary SPA	Pioneer, low-mid-upper saltmarshes	20 - 30	14.84
Severn Estuary SSSI	Pioneer, low-mid-upper saltmarshes	20 - 30	14.84
River Usk SAC	Watercourses – no comparable habitat with established critical load estimate	Not given	14.84
River Usk SSSI	Marshy grassland - no comparable habitat with established critical load estimate	Not given	14.84
Gwent Levels SSSI	Surface standing water – no comparable habitat with established critical load estimate	Not given	14.84
Newport Wetlands SSSI	Fen, marsh and swamp	15 - 30	14.84
	Neutral grassland	20 - 30	14.84
Duffryn Pond SINC	Rich fens	15 – 20	16.89
Julian's Gout Land SINC	Semi-improved marshy grassland	20 – 30	14.84
Gwent Wetland Reserve SINC	Pioneer, low-mid, mid-upper saltmarshes	20 - 30	14.84
Marshall's SINC	Neutral grassland (hay meadows)	20 – 30	17.56
Afon Ebbw River SINC	Semi-improved marshy grassland	20 – 30	17.56
Numerous Ancient Woodland	Broadleaved mixed and yew woodland	10 – 20	29.57

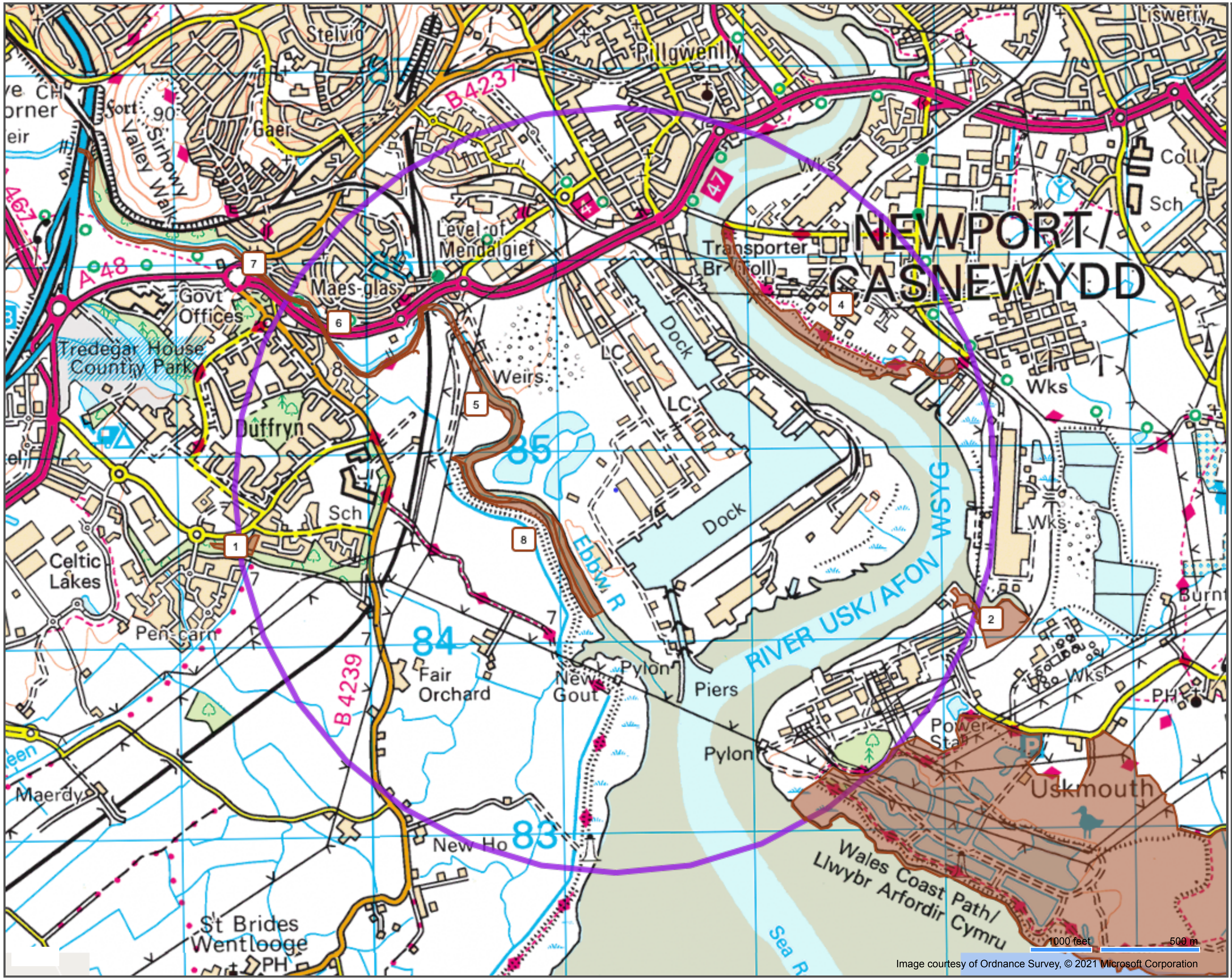
For acidic deposition, the critical load of a habitat site is largely determined by the underlying geology and soils. The critical load of acidification is defined by a critical load function (CLF), which describes the relationship between the relative contributions of sulphur (S) and nitrogen (N) to the total acidification.

The critical load function is defined by the following parameters:

- CLmaxS, the maximum critical load of acidity for S, assuming there is no N deposition;
- CLminN, is the critical load of acidity due to nitrogen removal processes in the soil only (i.e. independent of deposition); and
- CLmaxN, is the maximum critical load of acidity for N, assuming there is no S deposition.

Critical loads and background acid deposition rates have been obtained from APIS and are summarised in Table E4 for the identified habitat sites.

Table E4: Critical Loads for Acid Deposition (keq/ha/yr)				
Habitat Site	Critical Load (keq/ha/a)			Background Acidification (keq/ha/a)
	Max S	Min N	Max N	
Severn Estuary SAC	Habitat not sensitive to acidification			
Severn Estuary SPA	Habitat not sensitive to acidification			
Severn Estuary SSSI				
Acid grassland	0.84	0.223	1.063	1.14
Calcareous grassland	4.13	0.438	4.568	1.14
River Usk SAC	Site considered of low sensitivity to acidification (refer Appendix F, Section 3.4)			
River Usk SSSI	Site considered of low sensitivity to acidification (refer Appendix F, Section 3.4)			
Gwent Levels SSSI	Not applicable			-
Newport Wetlands SSSI	4.1	0.438	4.538	1.14
Duffryn Pond SINC	4.0	1.071	5.071	1.29
Julian's Gout Land SINC	4.0	1.071	5.071	1.14
Gwent Wetland Reserve SINC	Site considered of low sensitivity to acidification (refer Appendix F, Section 3.7)			
Marshall's SINC	4.0	1.071	5.071	1.40
Afon Ebbw River SINC	4.0	1.071	5.071	1.40
Numerous Ancient Woodland	10.969	0.357	11.326	2.22



Aderyn
LERC Wales' Biodiversity & Reporting Database

LOCAL ENVIRONMENTAL RECORDS CENTRES WALES
CANOLFANNAU COFNODION AMGYLCHEDDOL LLEOL CYMRU

eMapper for LERC Wales Aderyn Search
Amy_Hicks_11/03/2021_6047238 / 6047238
Locally designated sites

Key

Search Location
Search Buffer (2000m)

Adopted SINC

1: Duffryn Pond
2: Julian's Gout Land
3: Gwent Wetland Reserve
4: Marshall's
5: Afon Ebbw River
6: Afon Ebbw River
7: Afon Ebbw River
8: Afon Ebbw River

Aderyn
LERC Wales' Biodiversity & Reporting Database

LOCAL ENVIRONMENTAL RECORDS CENTRES WALES
CANOLFANNAU COFNODION AMGYLCHEDDOL LLEOL CYMRU

eMapper for LERC Wales Aderyn Search
Amy_Hicks_11/03/2021_6047238 / 6047238
Ancient woodlands

1000 feet
500 m

Image courtesy of Ordnance Survey, © 2021 Microsoft Corporation

Key

Search Location
Search Buffer (2000m)

Ancient Semi-natural Woodland
- **1**: Ancient Semi Natural Woodland
- **2**: Ancient Semi Natural Woodland
- **3**: Restored Ancient Woodland Site
- **4**: Restored Ancient Woodland Site
- **5**: Restored Ancient Woodland Site

Ancient Woodland Site of Unknown Category
- **1**: Ancient Woodland Site of Unknown Category

Appendix F – Argus Ecology Report – Ecological Interpretation of the Air Quality Assessment

Newport Energy Recovery Facility

Ecological interpretation of AQA

Prepared for Sol Environment Ltd.

Kevin Barry Honour MSc MCIEEM

Final Version 2.0 / ref. K22-005
28/02/2023

Unit 14 The Greenhouse Greencroft Industrial Park
Annfield Plain County Durham DH9 7XN

Newport Energy Recovery Facility

Ecological interpretation of AQA

Report Reference	ref. K22-005
Date	28/02/2023
Date of survey/s	n/a

Issue	Prepared by		Status	Date
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V2			FINAL	28/02/2023

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Contents

1 Introduction

This document provides an ecological interpretation of the Air Quality Assessment (AQA) undertaken by Sol Environment Ltd[1]. for an Biomass Processing Facility at Newport, South Wales ('the Facility'). The AQA was undertaken to inform an Environmental Permit (EP) application for the Facility, following approval by the local planning authority (Newport City Council) of a non-material amendment to the current planning consent ref. 19/0599.

The aim of this document is to provide further ecological interpretation of the results of the AQA, focussing on any impacts on sensitive ecological receptors which cannot be screened out as insignificant, in accordance with Natural Resources Wales' (NRW) criteria.

For impacts which cannot be screened out as inconsequential, further ecological assessment has been undertaken to:

- Confirm sensitivity of qualifying and notified features with reference to data published by the Air Pollution Information Service (APIS);
- Assess potential effects by comparing dispersion and deposition model plots with the spatial distribution of sensitive habitats;
- Consider existing site condition and additional factors, including catchment-level processes, which could increase or decrease sensitivity to the predicted effects; and
- Provide an informed ecological opinion on the likelihood of significant effects or significant harm.

[1] Sol Environment (2023). *Air Quality Assessment. Newport ERF.*

2 Scope and methodology

2.1 Scope of assessment

The scope of assessment is defined by the model results of the Air Quality Assessment (AQA) completed by Gair Consulting on behalf of Sol Environment Ltd. The AQA sets out the sensitive ecological receptors (Table 3.3), with locations shown of statutory designated sites (Figure 3.2) and locally designated Sites of Importance for Nature Conservation (SINC sites; Figure 3.3). Locations of statutory designated sites in the vicinity of the proposed development are shown in Figure 1 below; note all other sites within the wider 10km search radius were screened out from further consideration.

The AQA identified the following exceedances of NRW screening thresholds at statutory designated sites:

- Long-term (annual mean) oxides of nitrogen (NOx) levels at River Usk SAC and SSSI, where the predicted environmental concentration (PEC) exceeds 70% of the critical level for protection of ecosystems;
- Short-term (24hr mean) NOx levels at Severn Estuary SAC, SPA and SSSI; River Usk SAC and SSSI; and Gwent Levels - St. Brides SSSI where the process contribution (PC) exceeds 10% of the critical level;
- Nitrogen deposition rates to saltmarsh habitat at Severn Estuary SAC and SPA (at 20kg N/ha/yr lower critical load), where the PEC exceeds 70% of the critical load over part of the site;
- Nitrogen deposition rates to rich fen habitat (at 15kg N/ha/yr critical load) at Newport Wetlands SSSI and National Nature Reserve (NNR), where the PEC exceeds the critical load for the most sensitive supporting habitat;
- Nitrogen deposition rates to neutral grassland habitat (at 20kg N/ha/yr critical load) at Newport Wetlands SSSI and NNR, where the PEC exceeds 70% of the critical load over part of the site; and
- Acid deposition rates to wet grassland habitats (at acid grassland acidity class critical load) at Severn Estuary SSSI.

Note that the process contribution exceeds the 1% screening threshold for long-term (annual mean) ammonia (NH_3) levels on part of the above sites. However, the PEC is significantly less than 70% of the critical level of 3$\mu g/m^3$, which is appropriate for these sites. They can therefore be screened out from further consideration. There are also exceedances of the 1% threshold for annual mean sulphur dioxide (SO_2) levels, but the PEC remains well below the critical level, and can therefore also be screeded out.

Note also that there were no exceedances of screening thresholds at locally designated sites, in accordance with NRW guidance for environmental permitting purposes. These are modelled in the AQA, but not considered further in this assessment.

2.2 Methodology

Assessment methodology

Sensitivity of qualifying and notified features of designated sites was assessed with reference to the Air Pollution Information Service (APIS) website. Reference was also made to SSSI Citations published by Natural Resources Wales, where it was necessary to clarify the appropriate habitat present on the site. Current pressures, including possible air quality or eutrophication issues affecting European sites were assessed with reference to Natural Resources Wales' publications, including:

- Core Management Plan for River Usk Special Area of Conservation[2];
- Severn Estuary Indicative Site Level Condition Assessments[3];
- Special Protection Areas in Welsh Waters Indicative Site Level Condition Assessments[4]; and
- SAC and SPA Monitoring Results spreadsheets for the most recently available years (2017 & 2018)[5].

The spatial distribution of qualifying and notified features of the relevant designated sites (e.g. saltmarsh) were assessed using a combination of descriptions in the SAC and SSSI Citations, and interpretation of Google Earth aerial photography with an overlay of the designated site boundaries.

Background deposition rates used in the AQA were derived from the APIS GIS map tool, using the OS grid reference at the point of maximum modelled impact.

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[2] CCW (2008). *Core Management Plan including Conservation Objectives for River Usk Special Area of Conservation.* Version 1.5, 7th March 2008.
[3] NRW, 2018. *Severn Estuary / Môr Hafren Special Area of Conservation: Indicative site level feature condition assessments 2018*. NRW Evidence Report Series, Report No: 235, 41pp, NRW, Bangor
[4] NRW, 2018. *Special Protection Areas in Welsh waters: Indicative site level feature condition assessments 2018*. NRW Evidence Report Series, Report No: 236, 44pp, NRW, Bangor
[5] http://lle.gov.wales/catalogue/item/SACSPAMonitoringProgrammeResults (accessed 15/02/2023)

Catchment-level analysis

GIS data for the Usk catchment boundary was downloaded from the Lle website, together with the Wales Phase 1 Habitat Survey dataset. The Phase 1 survey was clipped to the Usk catchment, and habitat categories grouped in broader habitats relevant to the consideration of nutrient inputs to rivers. Areas of each broader habitat type within the catchment were then calculated from the Phase 1 data attribute table.

A literature search was undertaken for relevant studies of factors responsible for effects on water quality on the Usk catchment, in order to contextualise the results of the AQA. A key document consulted was NRW's assessment of Welsh river SACs against phosphorus targets, which included the Usk[6].

Evidence published by Natural England relating to nutrient neutrality considerations in English river catchments with SACs and SPAs was also consulted. This included evidence on export coefficients by land-use, and evidence of nutrient retention rates derived from the Farmscoper model and other sources.

2.3 Personnel

The report has been prepared by Kevin Barry Honour MSc MCIEEM, a freelance ecologist and Director of Argus Ecology Ltd. He specialises in ecological interpretation of air quality assessments, Habitats Regulations Assessment, Ecological Impact Assessment and habitat surveys (including UKHS / NVC / EUNIS). He has undertaken numerous interpretations of model outputs for point-source discharges, assessing effects on a wide variety of sites and habitat types.

He was previously a Senior Lecturer in Ecology at the University of Sunderland, with responsibility for teaching air pollution ecology at undergraduate and Masters level.

He has some knowledge of the River Usk and Gwent Levels area, having undertaken aquatic vegetation surveys on a number of sites in the 1990s for the Cardiff Bay Barrage mitigation works and for an industrial development in the Llandevenny area. These included the Uskmouth fly ash lagoons (now Newport Wetlands RSPB Reserve) and the Gwent Levels - Nash and Goldcliff SSSI.

[6] Hatton-Ellis TW, Jones TG. (2021). *Compliance Assessment of Welsh River SACs against Phosphorus Targets*. NRW Evidence Report No: 489, 96pp, Natural Resources Wales, Bangor

3 Sensitive ecological receptors

3.1 Severn Estuary SAC

Qualifying features and Site-relevant Critical Loads

The SAC is designated for the occurrence of the following qualifying features. They are set out in the table below, together with their sensitivity to nitrogen deposition and acid deposition, as defined by APIS in the Site Relevant Critical Loads web pages.

Table 3.1: Severn Estuary SAC qualifying features and site-relevant Critical Loads / Levels

Qualifying Feature	N dep. CL	Acid dep. CL
H1130 Estuaries	Saltmarsh component sensitive	Not sensitive
H1330 Atlantic salt meadows	20 - 30 kg N/ha/yr	
H1110 Sandbanks which are slightly covered by sea water all the time	Not sensitive	
H1140 Mudflats and sandflats not covered by seawater at low tide	No Critical Load assigned	
H1170 Reefs	Not sensitive	
S1095 - *Petromyzon marinus* - sea lamprey	Site specific - depends on N or P limitation of supporting habitat	Potential negative impact on supporting rivers and streams habitat
S1099 - *Lampetra fluviatilis* - river lamprey		
S1103 - *Alosa fallax* - twaite shad		

The 3μg/m^3 critical level for ammonia is appropriate for these habitats, as they do not support important lower plant (bryophyte or lichen) communities.

Background deposition rates

Using the APIS App, the nitrogen deposition rate at the point of maximum impact is modelled at 14.84kg N/ha/yr, 74.2% of the lower critical load for the most sensitive habitat (upper saltmarsh; 20kg N critical load).

3.2 Severn Estuary SPA

Qualifying features and Site-relevant Critical Loads

The following birds are listed by APIS as qualifying features of Severn Estuary SPA:

- Common shelduck *Tadorna tadorna*

- Common redshank *Tringa totanus*
- Greater white-fronted goose *Anser albifrons*
- Tundra swan *Cygnus columbianus bewickii*
- Gadwall *Anas strepera*

The most sensitive supporting habitat identified by APIS is saltmarsh, with a minimum critical load for nitrogen deposition of 20kg N/ha/yr. The SPA can therefore be regarded as having the same sensitivity to nitrogen deposition as the SAC, with the proviso that the effect pathway is indirect; for example, excess nitrogen deposition would have to result in changes in structure or species composition with the effect of making the supporting habitat less suitable for the species in question. Saltmarsh habitats are not regarded as sensitive to acid deposition, whilst the 3μg/m^3 critical level for ammonia is appropriate.

Background deposition rates

Using the APIS App, the nitrogen deposition rate at the point of maximum impact is modelled at 14.84kg N/ha/yr, 74.2% of the lower critical load for the most sensitive habitat (upper saltmarsh; 20kg N critical load).

3.3 Severn Estuary SSSI

Notified features and Site-relevant Critical Loads

The SSSI Citation published by NRW[7] lists a number of different habitats, additional to the qualifying features of the SAC and SPA. They include two swamp communities of pools in the upper saltmarsh, comprising stands of *Phragmites australis* (common reed) and *Bolboschoenus (Scirpus) maritimus* (sea club-rush), and two wet grassland communities (National Vegetation Classification (NVC) communities MG11 and MG12).

APIS GIS map tool does not identify these plant communities as notified features, and recommends 20kg N/ha/yr as the lowest critical load to apply to upper saltmarsh, as a supporting habitat of some of the notified bird species.

With respect to acid deposition, the APIS tool identifies coastal grassland as having the highest sensitivity, with critical loads (minCLmaxN) values of 1.063keq/ha/yr for acid grassland broad habitat, and 4.568keq/ha/yr for calcareous grassland broad habitat. Use of the acid grassland broad habitat could be reasonably regarded as over-

[7] https://naturalresources.wales/media/643756/SSSI_0461_Citation_EN001f09c.pdf

precautionary; coastal grasslands are likely to be well-buffered against acid deposition, so use of the calcareous grassland critical load of 4.568keq/ha/yr is justified. Saltmarsh habitats are not regarded by APIS as sensitive to acid deposition.

3.4 River Usk SAC

Qualifying features and Site-relevant Critical Loads

The SAC is designated for the occurrence of the following qualifying features. They are set out in the table below, together with their sensitivity to nitrogen deposition and acid deposition, as defined by APIS in the Site Relevant Critical Loads web pages.

Table 3.2: River Usk SAC qualifying features and site-relevant Critical Loads / Levels

<table>
<tr><th>Qualifying Feature</th><th>N dep. CL</th><th>Acid dep. CL</th></tr>
<tr><td>H3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitrichio-Batrachion vegetation</td><td>Site specific - no critical load assigned to EUNIS classes for meso/ eutrophic systems. Sensitivity depends on N or P limitation.</td><td>Sensitive to acidity; no critical load assigned</td></tr>
<tr><td>S1095 - Petromyzon marinus - sea lamprey</td><td rowspan="8">Site specific - no critical load assigned. Sensitivity depends on N or P limitation of supporting habitat.</td><td rowspan="8">Rivers and streams supporting habitat sensitive to acidity with potential negative effects on fish. No critical load assigned</td></tr>
<tr><td>S1096 - Lampetra planeri - brook lamprey</td></tr>
<tr><td>S1099 - Lampetra fluviatilis - river lamprey</td></tr>
<tr><td>S1102 - Alosa alosa - Allis shad</td></tr>
<tr><td>S1103 - Alosa fallax - Twaite shad</td></tr>
<tr><td>S1106 - Salmo salar - Atlantic salmon</td></tr>
<tr><td>S1163 - Cottus gobio - Bullhead</td></tr>
<tr><td>S1355 - Lutra lutra - Otter</td></tr>
</table>

With respect to water courses of plain to montane levels and the species which are dependent on this habitat, APIS advise that aquatic systems are often P limited or N/P co-limited (therefore additional N will have less effect, as it is not a limiting nutrient). They also state that '*consideration should also be given to other sources of N, i.e. discharges to water, diffuse agricultural pollution etc.*' This is discussed further below in the context of catchment-scale processes, as it is important to interpret these in terms of data on other sources of nitrogen and the importance of phosphate inputs to eutrophication issues within the wider Usk catchment.

No critical loads have been set with respect to acid deposition; sensitivity to acid deposition is discussed below in relation to catchment geology.

Background deposition rates

Using the APIS App, the nitrogen deposition rate at the point of maximum impact is modelled in the AQA at 14.84kg N/ha/yr.

Catchment-level sensitivity

The River Usk *Core Management Plan*[8] provides an outline description of the catchment, stating: ' *The underlying geology consists predominantly of Devonian Old Red Sandstone with a moderate base status, resulting in waters that are generally well buffered against acidity. This geology also produces a generally low to moderate nutrient status, and a moderate base-flow index, intermediate between base-flow dominated rivers and more flashy rivers on less permeable geology. The run-off characteristics and nutrient status are significantly modified by land use in the catchment, which is predominantly pastoral with some woodland and commercial forestry in the headwaters and arable in the lower catchment'.*

The catchment therefore has a relatively low sensitivity to acid deposition. However it can be regarded as sensitive to nutrient enrichment, with agricultural land management identified in the *Core Management Plan* as an issue in some parts of the catchment. The qualifying feature 'Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachian* vegetation is recognised as sensitive to nutrient enrichment, with the characteristic submerged aquatic plant species of the community being replaced by algae. Control of diffuse phosphate pollution in particular is cited as a management requirement to achieve favourable conservation status. The conservation status of other qualifying features such as Atlantic salmon is also dependent on water quality.

The Water Framework Directive (WFD) Cycle 2 2018 Interim Classification spreadsheet gives a 'moderate' overall status and ecological status to several reaches and tributaries, with phosphate levels and fish identified as the drivers of ecological quality, and most frequent reasons for not achieving 'good' status. The more recent Compliance Assessment of the River Usk catchment with respect to phosphate targets[9] found widespread failures, with relatively high phosphate levels particularly in the main

[8] CCW (2008). *Core Management Plan including Conservation Objectives for River Usk Special Area of Conservation.* Version 1.5, 07 March 2008.
[9] Hatton-Ellis TW, Jones TG. 2021. *op. cit.*

river. It is clear from this document that control of phosphate levels is the key requirement for the River Usk SAC in terms of meeting 'good' ecological status under the WFD, and favourable conservation status or the SAC under the Habitats Regulations.

The focus on control of phosphate levels implies that the river is regarded as being primarily phosphate-limited. This accords with evidence for a greater potential for P-limitation in rivers, relative to headwater streams[10].

Habitats and land-use within catchment

Analysis of catchment land-use using GIS analysis of the NRW Phase 1 Habitat Survey dataset for Wales produced the following breakdown of habitats in the Usk catchment. Their spatial disposition is shown in Figure 3; this illustrates the predominance of agriculturally improved grassland within the catchment, with almost half the total catchment area. Forestry and upland habitats dominate the headwaters, with urban and industrial habitats in the lower reaches, including Newport and the Llanwern steelworks site.

Table 3.3: Habitats within Usk catchment

P1 code	Phase 1 Habitat type	Area (ha)	% of total
B4	improved grassland	63335.86	47.8
mosaic	mosaic (upland habitats)	11379.79	8.6
B1/B2/B3	unimproved / semi-improved grassland	10508.88	7.9
A1.2	coniferous woodland	8610.52	6.5
A1.1	broadleaved woodland	7192.02	5.4
J1.1	arable land	6560.64	4.9
D	heathland	5732.70	4.3
J2-J4	urban / developed	5551.40	4.2
C1/C2/C3	tall herb - bracken	5219.72	3.9
B5	marshy grassland	2310.37	1.7
Unknown	unknown / unclassified	1723.65	1.3
G	open water	1240.71	0.9
J1.2-1.4	urban vegetated	980.28	0.7
E1	raised and blanket bogs	625.21	0.5
A2/A3/A4	rock exposure and waste	514.55	0.4
I	scrub / scattered trees	497.86	0.4

[10] Jarvie, H.P., Smith, D.R., Norton, L.R., Edwards, F.K., Bowes, M.J., King, S.M., Scarlett, P., Davies, S., Dils, R.M., Bachiller-Jareno, N. (2018). Phosphorus and nitrogen limitation and impairment of headwater streams relative to rivers in Great Britain: A national perspective on eutrophication. *Science of The Total Environment,* **621**, pp. 849-862.

P1 code	Phase 1 Habitat type	Area (ha)	% of total
E2-F2	mire and swamp	424.67	0.3
H	coastal habitats	198.13	0.1
	Total areas	132606.98	100

Consideration of land-use within the catchment allows atmospheric nutrient deposition to be viewed in the context of existing nutrient sources, as well as allowing an assessment of the likely magnitude of retention and attenuation of deposition to land.

3.5 River Usk (Lower Usk) SSSI

Notified Features and Site-relevant Critical Loads

The NRW publication *River Usk (Lower Usk) Site of Special Scientific Interest - Your Special Site and Its Future*[11] states there are four special features, three of which are shared with the SAC:

- Running water supporting *Ranunculion* vegetation;
- Otter;
- Fish species (including Atlantic salmon; Twaite and Allis shad; sea, river and brook lamprey; bullhead) and
- A group of rare craneflies.

The 'Special Sites' publication mentions contributory habitats including woodland, grassland, swamp and marginal vegetation, bracken, mudflats and saltmarsh. The SSSI Citation document lists silty river margins as being important for the cranefly fauna. Associated flora include marginal saltmarsh in the lower tidal reaches; marginal swamp vegetation; willow / alder woodland; and inundation grasslands.

The APIS GIS map tool lists standing water, otter, and the fish species as SSSI notified features. It does not give any critical loads for nitrogen deposition, stating that the sensitivity depends on N or P limitation. For acid deposition, the features are regarded as potentially sensitive due to impacts on their supporting habitat, but no critical load is given.

[11] https://naturalresources.wales/media/663771/SSSI_1425_SMS_EN001cbe6.pdf

Background deposition rates

Using the APIS App, the background nitrogen deposition rate at the point of maximum impact is given in the AQA at 14.84kg N/ha/yr.

3.6 Newport Wetlands SSSI

Notified features and Site-relevant Critical Loads

The NRW *Your Special Site and its Future* publication for the SSSI[12] lists six groups of notified features:

- Reens and ditches;
- Reedbeds;
- Higher plants - rare and scarce plants including rootless duckweed (*Wolffia arrhiza*) and hairlike pondweed (*Potamogeton trichoides*);
- Over-wintering birds - including nationally important numbers of shoveler (*Spatula clypeata*) and black-tailed godwit (*Limosa limosa*);
- Breeding birds - exceptional assemblage of breeding birds, with nationally important numbers of Cetti's warbler (*Cettia cettia*) and water rail (*Rallus aquaticus*);
- Insects and other invertebrates, including a diverse aquatic invertebrate fauna in the reens and ditches; a nationally scarce spider found in reedbeds; and the shrill carder bee (*Bombus sylvarum*) associated with flower-rich unmown grasslands and ditch banks.

NRW list supporting habitats which contribute to the site's wildlife interest as comprising lowland wet grassland, hedgerows and scrub.

The APIS GIS app lists 9 features: standing water; hairlike pondweed; shrill carder bee; a soldier fly (*Odontomyia ornata*); shoveler; Cetti's warbler; bearded tit (*Panurus biarmius*); water rail; and redshank (*Tringa totanus*).

Sensitivity to nitrogen deposition

In terms of sensitivity to nitrogen deposition, APIS list rich fens (EUNIS class D4.1) as supporting habitat of water rail, with a critical load of 15 - 30 kg N/ha/yr. Saltmarsh habitats (A2.53; A2.54; A2.55) and low and medium altitude hay meadows (E2.2) are

[12] https://naturalresources.wales/media/677494/sssi_3123_sms_en001.pdf

both listed as supporting habitat of redshank; both have a critical load of 20 - 30kg N/ha/yr.

Sensitivity of water rail to nitrogen deposition

The identification by APIS of water rail as the most sensitive feature with respect to nitrogen deposition is difficult to understand in terms of its habitat requirements, particularly in the context of Newport Wetlands SSSI. Water rail are a skulking species associated with dense waterside vegetation. Although water rail do utilise rich fen vegetation where it is sufficiently dense to provide cover, *Your Special Site and its Future* identifies water rail at Newport Wetlands as primarily associated with the extensive reedbeds which are also a notified feature of the SSSI.

Prior to developing the APIS GIS app, their Site-relevant Critical Loads previously misallocated the reedbed community (National Vegetation Classification (NVC) community S4, *Phragmites australis* (common reed) swamp and reed-beds) to the rich fens critical load class (EUNIS habitat D4.1). This is incorrect - NVC S4 is more accurately assigned to EUNIS habitat C3.21 (water-fringing reedbeds; *Phragmites australis* reedbeds). While regarded as potentially sensitive to eutrophication, this community does not have a critical load assigned, and can be regarded as less sensitive than rich fen habitat. The APIS GIS app now recognises this, as reedbeds are not given a critical load, so the identification of a species utilising reedbed as a supporting habitat as more sensitive therefore seems anomalous.

Sensitivity to acid deposition

With respect to acid deposition, APIS provides a choice of either acid or calcareous grassland broad habitats for assessment purposes, for redshank supporting habitat. In the case of Newport Wetlands, given the derivation of the more recently established grasslands from an alkaline fly ash substrate, and the lowland coastal location of more established ditch-side grasslands, the calcareous grassland critical load is more appropriate. This is given by APIS as 5.071keq/ha/yr (MinCLmaxN), a higher value than the 4.528keq/ha/yr given for acid grassland broad habitat. Neither indicate a habitat of particular sensitivity to acid deposition in this location.

Background deposition rates

Using the APIS App, the background nitrogen deposition rate at the point of maximum impact is given in the AQA at 14.84kg N/ha/yr. This is just below the lower critical load for the most sensitive supporting habitat.

Maximum acid deposition rates are modelled at a total of 1.2keq H^+(N+S)/ha/yr, well below the critical load for sensitive habitats in this location.

3.7 Gwent Levels SSSI

Notified features and Site-relevant Critical Loads

The NRW *Your Special Site and its Future* publication for Gwent Levels - St. Brides SSSI SSSI lists three groups of notified features:

- Reen and ditch habitat;
- Insects and other invertebrates; and
- Shrill carder bee.

The Gwent Levels - Nash and Goldcliff to the east of the River Usk also lists the same notified features. Supporting habitat includes flower-rich unmown ditch banks for shrill carder bee and other invertebrates (including those with aquatic stages in their life-cycle).

As noted in the context of Newport Wetlands SSSI, reens and ditches can be regarded as a subset of EUNIS habitat C1 (surface standing waters). APIS does not assess them as sensitive to nitrogen or acid deposition, but states that site-specific advice should be sought.

In terms of their ecology, the reens clearly are potentially sensitive to eutrophication; it is well established that vascular plant-dominated aquatic communities which are an important element of Gwent Levels' flora would be replaced by species-poor algal dominated vegetation under conditions of high nutrient levels. However, they are relatively nutrient-rich, as evidenced by elevated conductivity readings in previous surveys in excess of 1000µS/cm[13] (Argus Ecology data), and most reens exist in a landscape of improved grassland and (in some areas) arable agriculture. Some of the most important species such as hairlike pondweed and the hornworts (*Ceratophyllum spp.*) are known to be maintained through periodic maintenance operations, while rootless duckweed is associated with a small number of reens close to the Severn Estuary, where there is some brackish influence. Their lowland, coastal situation means they are likely to be very well-buffered from acidic inputs, and therefore cannot be regarded as sensitive to acid deposition.

[13] Microsiemens per 1cm wide electrode bridge

In addition to standing waters, the APIS GIS app lists hairlike pondweed, shrill carder bee, and the soldier-fly *Odontomyia ornata* as site features. None have a critical load assigned for nitrogen or acid deposition, and sensitivity has not been assessed by APIS.

Background deposition rates

Using the APIS App, the background nitrogen deposition rate at the point of maximum impact is given in the AQA at 14.84kg N/ha/yr.

3.8 Distribution of qualifying features in vicinity of emission source

A combination of aerial photograph interpretation and the Wales Phase 1 Habitat map with an overlay of designated site boundaries can provide an indication of the occurrence of sensitive habitats in the vicinity of the emission source. Figure 2 illustrates the spatial disposition of sensitive habitats at or close to points used to model pollutant concentrations and deposition rates as a consequence of the proposed development. This shows saltmarsh within the River Usk, Newport Wetlands and Severn Estuary sites, as well as some areas of unimproved and semi-improved grassland; note other grassland sites mapped as improved grassland on the Phase 1 map have been considered as neutral grassland in the assessment of sensitive receptors, reflecting in particular the changed management of these habitats within Newport Wetlands SSSI.

4 Ecological assessment of air quality effects

4.1 Oxides of nitrogen - long-term

AQA predictions

The following table summarises the modelled predictions in the AQA for the PC to annual mean NOx levels, including background and predicted environmental concentration (PEC):

Table 4.1: Predicted annual mean NOx levels

Site	Background NOx	PC (μg/m^3)	PC % of CL	PEC (μg/m^3)	PEC % of CL
Severn Estuary SAC	12.23	0.47	1.6%	12.7	42.3%
Severn Estuary SPA	12.23	0.47	1.6%	12.7	42.3%
Severn Estuary SSSI	12.23	0.47	1.6%	12.7	42.3%
River Usk SAC	22.63	1.19	4.0%	23.8	79.4%
River Usk (Lower Usk) SSSI	22.63	1.19	4.0%	23.8	79.4%
Gwent Levels - St Brides SSSI	15.92	0.64	2.1%	21.4	55.2%
Newport Wetlands SSSI	11.55	0.34	1.1%	11.9	39.6%

Note that the PECs for River Usk SAC and River Usk (Lower Usk) SSSI are both above 70% of the critical level, and therefore cannot be screened out from further consideration in accordance with NRW & Environment Agency guidance.

Ecological effects

IAQM (2020) guidance[14] (paragraph 5.5.3.2) emphasises that the 70% PEC threshold is a trigger for detailed dispersion modelling, and is not a damage threshold. Detailed deposition modelling has been undertaken in the AQA; in terms of assessing potential ecological effects, it is important to assess whether there is any risk that the critical level would be exceeded through changes in background levels.

[14] Holman *et al* (2020). *A guide to the assessment of air quality impacts on designated nature conservation sites – version 1.1,* Institute of Air Quality Management, London

There is a downward trend in oxidised nitrogen levels. Analysis of air quality monitoring data in UK by Air Quality Consultants[15] showed an significant overall trend of -1.86% per annum for NOx during the period 2005-2018, with a steeper decline of -3.04% for NOx from 2010-2018. This trend is explained by the authors as a consequence of the closure of coal-fired power plants, and more stringent emissions controls on vehicle emissions such as the Euro VI standard. Although the authors caution that this trend may flatten out in the future without further changes in vehicle emission factors (e.g. through greater uptake of electric vehicles (EVs)), it is very unlikely that there would be an future uptrend. It is therefore extremely unlikely that the critical level for NOx will be exceeded in the future at any of the sites considered in the assessment.

4.2 Oxides of nitrogen - short-term

AQA predictions

The following table summarises the modelled predictions in the AQA for the PC to short term (24 hour mean) NOx levels; the screening threshold is defined as 10% of the lower critical level of 75μg/m^3.

Table 4.2: Predicted short-term (24-hour) NOx levels

Site	PC (μg/m^3)	PC % of CL
Severn Estuary SAC	9.6	12.8%
Severn Estuary SPA	9.6	12.8%
Severn Estuary SSSI	9.6	12.8%
River Usk SAC	8.9	11.9%
River Usk SSSI	8.9	11.9%
Gwent Levels - St Brides SSSI	10.3	13.7%
Newport Wetlands SSSI	2.7	3.5%

Environment Agency guidance for screening purposes advises that short-term background levels can be estimated by multiplying the annual mean by a factor of 2. Taking the background figures in Figure 4.1 together with the predicted PC above, the worst-case prediction for the PEC for River Usk SAC and River USk (Lower Usk) SSSI is

[15] Air Quality Consultants (2019). *Nitrogen Dioxide and Nitrogen Oxides Trends in the UK 2005 to 2018*. October 2019. https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=feb92332-26f7-4989-b86a-21e5732a5404.

for a 24-hour mean of 54.16µg/m³ ((22.63 x2) + 8.9), or 72.2% of the 75µg/m³ critical level, just over the 70% screening threshold. At all other sites the PEC is below 70% of the critical level.

Ecological effects

Although it is possible for short-term elevated NOx levels to cause damage to vegetation, the effects of such episodic pollution are exacerbated in circumstances where ozone (O_3) and sulphur dioxide (SO_2) levels are also elevated. It is in these circumstances that the 75µg/m³ critical level is most appropriate.

IAQM (2020) guidance (paragraph D4.9) suggests in UK where SO_2 and O_3 levels are low that the 4-hour mean critical level of 200µg/m³ can be applied to 24-hour mean values. The AQA notes that background SO_2 levels are low throughout the area, with a maximum value of just over 20% of the critical level. Ozone levels are more difficult to predict as they are episodic, but are typically higher in more rural areas.

Given that the PEC for short-term NOx is well below both critical levels, there is no risk of short-term NOx levels affecting vegetation and habitats at River Usk SAC and River Usk (Lower Usk) SSSI, or any other sites considered in the assessment.

4.3 Ammonia levels - long term

AQA predictions

The following table summarises the modelled predictions for ammonia levels at statutory designated sites.

Table 4.3: Predicted long-term (annual mean) NH_3 levels

Site	Background NH_3 (µg/m³)	PC (µg/m³)	PC % of CL	PEC (µg/m³)	PEC % of CL
Severn Estuary SAC	1.87	0.039	1.3%	1.91	63.6%
Severn Estuary SPA	1.87	0.039	1.3%	1.91	63.6%
Severn Estuary SSSI	1.87	0.039	1.3%	1.91	63.6%
River Usk SAC	1.87	0.099	3.3%	1.97	65.6%
River Usk (Lower Usk) SSSI	1.87	0.099	3.3%	1.97	65.6%
Gwent Levels - St Brides SSSI	1.87	0.053	1.8%	1.92	64.1%

Site	Background NH_3 (μg/m^3)	PC (μg/m^3)	PC % of CL	PEC (μg/m^3)	PEC % of CL
Newport Wetlands SSSI	1.87	0.053	0.9%	1.90	63.3%

Ecological effects

Although in all cases the modelled process contribution exceeds the 1% threshold by a small magnitude, the PEC does not exceed 70% of the critical level at any of the sites. There is therefore no requirement for further ecological assessment of ammonia levels.

4.4 Nitrogen deposition rates

AQA predictions

The following table summarises the AQA predictions for nitrogen deposition rates to designated sites. Critical loads are based on the analysis of sensitivity set out in the preceding chapter, and relate to saltmarsh and coastal grazing marsh habitats (both 20kg N/ha/yr). Note that for all relevant habitats the background deposition rates and process contributions are based on grassland / heathland deposition velocity.

Table 4.4: Predicted nitrogen deposition rates (kg N/ha/yr)

Site	Background	Critical Load	PC	PC % of CL	PEC	PEC % of CL
Severn Estuary SAC	14.84	20	0.27	1.35%	15.11	75.6%
Severn Estuary SPA	14.84	20	0.27	1.35%	15.11	75.6%
Severn Estuary SSSI	14.84	20	0.27	1.35%	15.11	75.6%
River Usk SAC	14.84	See below	0.68	n/a	15.52	n/a
River Usk SSSI	14.84	See below	0.68	n/a	15.52	n/a
Gwent Levels - St Brides SSSI	14.84	None given	0.37	n/a	15.21	n/a
Newport Wetlands SSSI (water rail)	14.84	15	0.20	1.33%	15.04	100.3%

Site	Background	Critical Load	PC	PC % of CL	PEC	PEC % of CL
Newport Wetlands SSSI (saltmarsh / grassland)	14.84	20	0.20	1.0%	15.04	75.2%

Ecological effects

There is one exceedance of the lower critical load for rich fen habitat, due to a predicted small magnitude (0.2kg N/ha/yr) increase in nitrogen deposition at Newport Wetlands SSSI. However, as discussed in section 3.6 above, water rail at this site appear to be primarily associated with less sensitive reedbed habitats, and there does not seem to be a clear conceptual effect pathway whereby effects on rich fen supporting habitat would negatively affect this species.

None of the other PECs exceed the critical load for nitrogen deposition for the most sensitive habitat present, but for upper saltmarsh habitats at River Usk SSSI, and upper saltmarsh / coastal grazing marsh habitat at Severn Estuary SAC and SPA and Newport Wetlands SSSI they exceed the 70% screening threshold, and require further ecological interpretation.

There is less certainty regarding the future trajectory of nitrogen deposition rates; although the contribution of oxidised nitrogen compounds is expected to continue to fall, future trends in reduced nitrogen compounds (NHx) are less certain. As an example, the APIS trends section for River Usk SAC shows a clear decline in NOx levels and the contribution of oxidised nitrogen compounds to nitrogen deposition, but a relatively flat and fluctuating trend in reduced N. However, there remains sufficient headroom between the PEC and the critical loads to be confident that they will not be exceeded in the future, and therefore no risk of an ecological effect of nitrogen deposition on sensitive habitats.

Catchment scale effects of nitrogen deposition in the River Usk are discussed in more detail in section 4.5 below.

4.4 Acid deposition rates

AQA predictions

The following table summarises the AQA predictions for acid deposition rates to designated sites. Critical loads are based on the analysis of sensitivity set out in the preceding chapter, with coastal and floodplain grazing marsh habitat assigned the precautionary 'acid grassland' broad habitat critical load in accordance with APIS advice. Note that for all relevant habitats the background deposition rates and process contributions are based on grassland / heathland deposition velocity.

Table 4.5: Predicted acid deposition rates (keq H^+/ha/yr)

Site	Background	Critical Load (minCLmaxN)	PC (total)	PC % of CL	PEC	PEC % of CL
Severn Estuary SAC	1.14	n/a	0.034	n/a	1.17	n/a
Severn Estuary SPA	1.14	n/a	0.034	n/a	1.17	n/a
Severn Estuary SSSI (acid grassland)	1.14	1.063	0.034	3.2%	1.17	110.1%
Severn Estuary SSSI (calcareous gsld.)	1.14	4.568	0.034	0.74%	1.17	25.6%
River Usk SAC	1.14	n/a	0.068	n/a	1.23	n/a
River Usk SSSI	1.14	n/a	0.068	n/a	1.23	n/a
Gwent Levels - St Brides SSSI	1.14	n/a	0.046	n/a	1.19	n/a
Newport Wetlands SSSI	1.14	4.528	0.025	0.55%	1.16	25.6%

Ecological effects

The only predicted impact which exceeds the 1% screening threshold is at Severn Estuary SSSI, with a predicted process contribution of 3.2% for coastal grasslands, in circumstances where background levels already exceed the critical load. However, this is based on acid grassland broad habitat, which is not appropriate in what are likely to be well-buffered soils. For calcareous grassland broad habitat, the PC is well below 1% and the PEC remains well below the critical load.

For wet grassland habitat at Newport Wetlands SSSI the PC is well below 1% and PEC well below the critical load, based on acid grassland broad habitat. Calcareous grassland broad habitat is also more appropriate here, and would further reduce both the PC and PEC as a proportion of the critical load.

4.5 Catchment-scale effects - River Usk SAC and River Usk (Lower Usk) SSSI

AQA predictions

As explained in the AQA, the total nitrogen deposition to the Usk catchment was modelled over an extensive area extending 31km north of the proposed development, and extending to a total of area of 51,906ha, around 39% of the total catchment area. The model produced the following results for deposition to land, tabulated below:

Table 4.6: Modelled total deposition to Usk catchment

	Catchment area within model (ha)	**Average PC (kg N/ha/yr)**	**Catchment total (kg N/yr)**
Oxidised N deposition (NOx)	51906	0.0042	109
Reduced N deposition (NHx)		0.013	329
Total N deposition		**0.017**	**438**

In order to assess the significance of this figure and any potential ecological effects, it is helpful to view it in the context of other nutrient nitrogen inputs to the catchment. It is also important to try and estimate the likely retention of deposited nitrogen within the catchment, to assess what proportion of atmospheric deposition is likely to reach the river.

Relative importance of atmospheric nitrogen inputs

In order to assess potential catchment-scale effects on the River Usk, it is necessary to consider the relative importance of atmospheric nitrogen inputs relative to land-based sources. It is clear that land-based sources are much more significant in the River Usk; a European Environment Agency (EEA) source apportionment study[16] stated that atmospheric deposition is much smaller than diffuse agricultural pollution, and is only significant on large open water bodies such as the Baltic Sea or large lakes, where the surface area is large relative to catchment size.

[16] European Environment Agency (2005). *Source Apportionment of nitrogen and phosphorus inputs to the aquatic environment.* EEA Report No. 7/2005.

As noted in Table 3.3 above, the Usk catchment has 47.8% of total land-cover as improved agricultural grassland, covering a total area of 63335ha, and 4.9% of the catchment, totalling 6560ha as arable land. Nitrogen fertiliser inputs to agricultural land will be limited from April 2023 to 170kg N/ha/yr under the Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021, which designate the whole of Wales as a Nitrate Vulnerable Zone (NVZ). Taking improved grassland alone, this will still allow the application of 10.76 million kg N/yr (10766 tonnes/yr) to the Usk catchment; the total contribution from the proposed development represents 0.004% of this total, an inconsequential effect.

Retention of nitrogen deposition within catchment

The relationship of nitrogen deposition to terrestrial vegetation and nitrogen levels in watercourses is complex. Inputs will be sequestered in plant biomass or immobilised in the soil organic nitrogen pool, or released back to the atmosphere through denitrification. Part of the dissolved nitrogen will be retained in groundwater, giving a time-lag between deposition and river concentrations.

For English rivers with SAC and SPA sites affected by nutrient enrichment, Nutrient Neutrality methodology addresses nutrient exports to water from a range of different land uses. Although values are catchment-specific and depend on variables such as geology and rainfall, typical values are given of around 20kg total N/ha/yr for arable crops, 19kg for dairy farming, and 10kg for grassland. Urban land, urban greenspace and woodland are estimated at around 3kg total N/ha/yr. It is reasonable to assume figures of comparable magnitude would apply to the Usk catchment.

When export coefficients to watercourses are compared to values for nitrogen inputs to land over a range of different land-uses. a value of 90% retention appears reasonable to apply across agricultural land, urban and semi-natural habitats[17]. This implies an annual input to the Usk catchment of around 87.6kg N/yr, an inconsequential contribution in the context of other inputs.

Potential for significant ecological effect

The predicted nitrogen input to the catchment is extremely low as a proportion of baseline values, and would not be likely to produce any measurable difference in nitrogen levels in the River Usk. In addition, although reduction of nutrient nitrogen in

[17] Argus Ecology (2022). *Newton Aycliffe Clinical Waste Incinerator. Tees Catchment study - ecology*. Report for Industrial Development Projects, planning appeal ref. APP/X1355/W/22/3292099

rivers is clearly a desirable aim, the focus in the River Usk SAC and SSSI is very much on reducing phosphate levels as providing the greatest ecological benefit, as the main river is believed to be phosphorus-limited.

The impact of nitrogen deposition to the Usk catchment can therefore be regarded as inconsequential, with no risk of a likely significant effect.

5 Conclusions

Further ecological interpretation of the results of the dispersion and deposition modelling undertaken in the AQA has been carried out, including further consideration of habitat sensitivities to pollutant impacts. No exceedances of the critical level for long or short-term oxides of nitrogen levels, or for ammonia levels are predicted as a consequence of the proposed development. Following allocation of the most appropriate critical loads for nitrogen and acid deposition, no exceedances of the relevant environmental quality standards are predicted as a consequence of the proposed development.

With respect to River Usk SAC, the main habitat considered in the assessment is the river itself, which forms part of the Rivers of Plain to Montane Levels Annex I habitat and SAC qualifying feature. Although this habitat does not have a critical load assigned for acid or nitrogen deposition, it is regarded as sensitive. Several qualifying species can also be regarded as sensitive, due to indirect effects on the river as a supporting habitat. There are also equivalent notified features of the River Usk (Lower Usk) SSSI with comparable sensitivities. A catchment-level assessment was therefore undertaken to ensure proper consideration of this feature. This concluded that the predicted nitrogen deposition rates were inconsequential, relative to nitrogen inputs to agricultural grassland, and the overriding problem of phosphorus pollution.

In conclusion, no likely significant effects are predicted on qualifying features of the SAC, and no significant harm is predicted for notified features of the SSSI.

Fig.1: Location of statutory designated sites in vicinity of proposed development

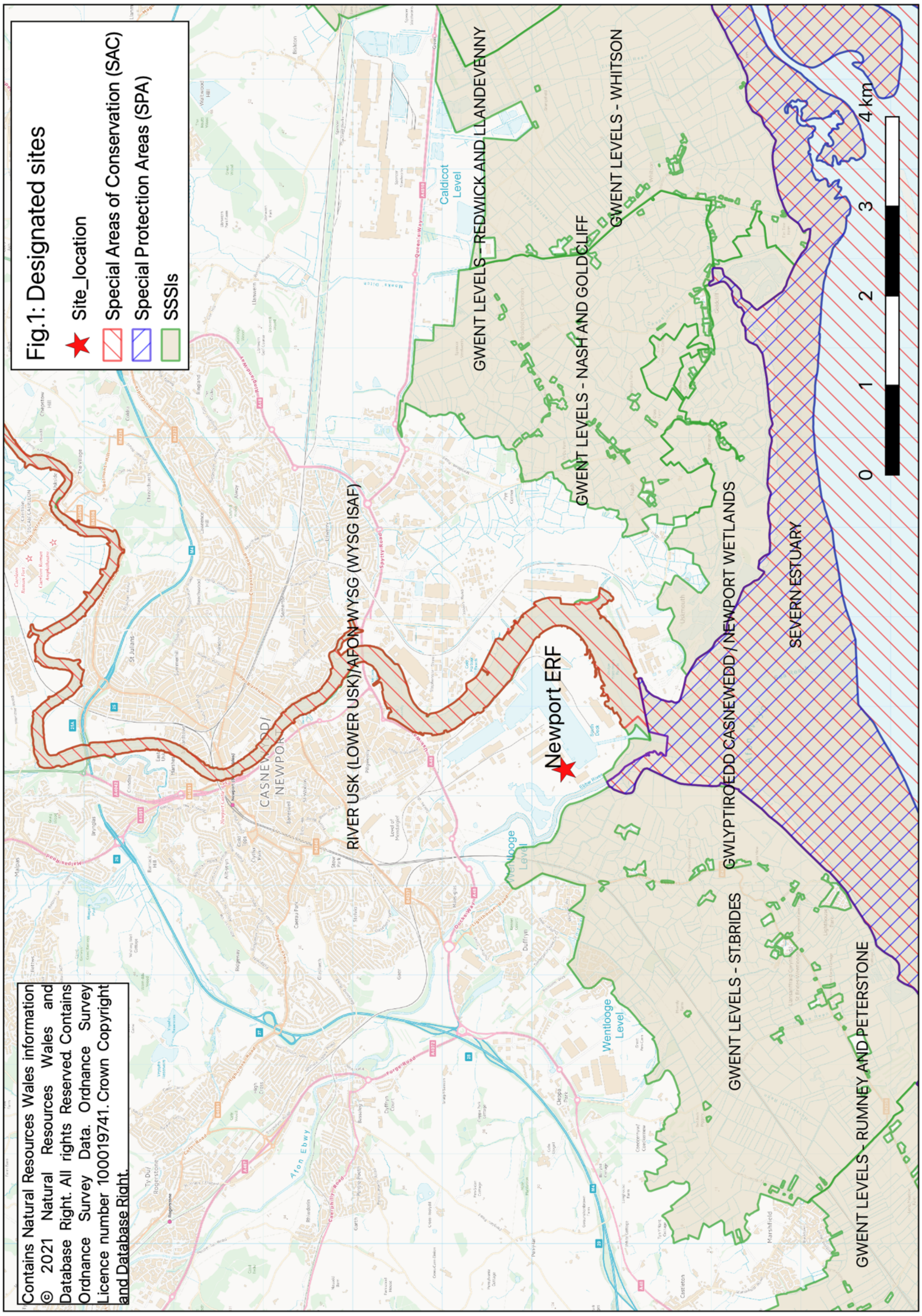

Fig.2: Sensitive habitats in vicinity of proposed development

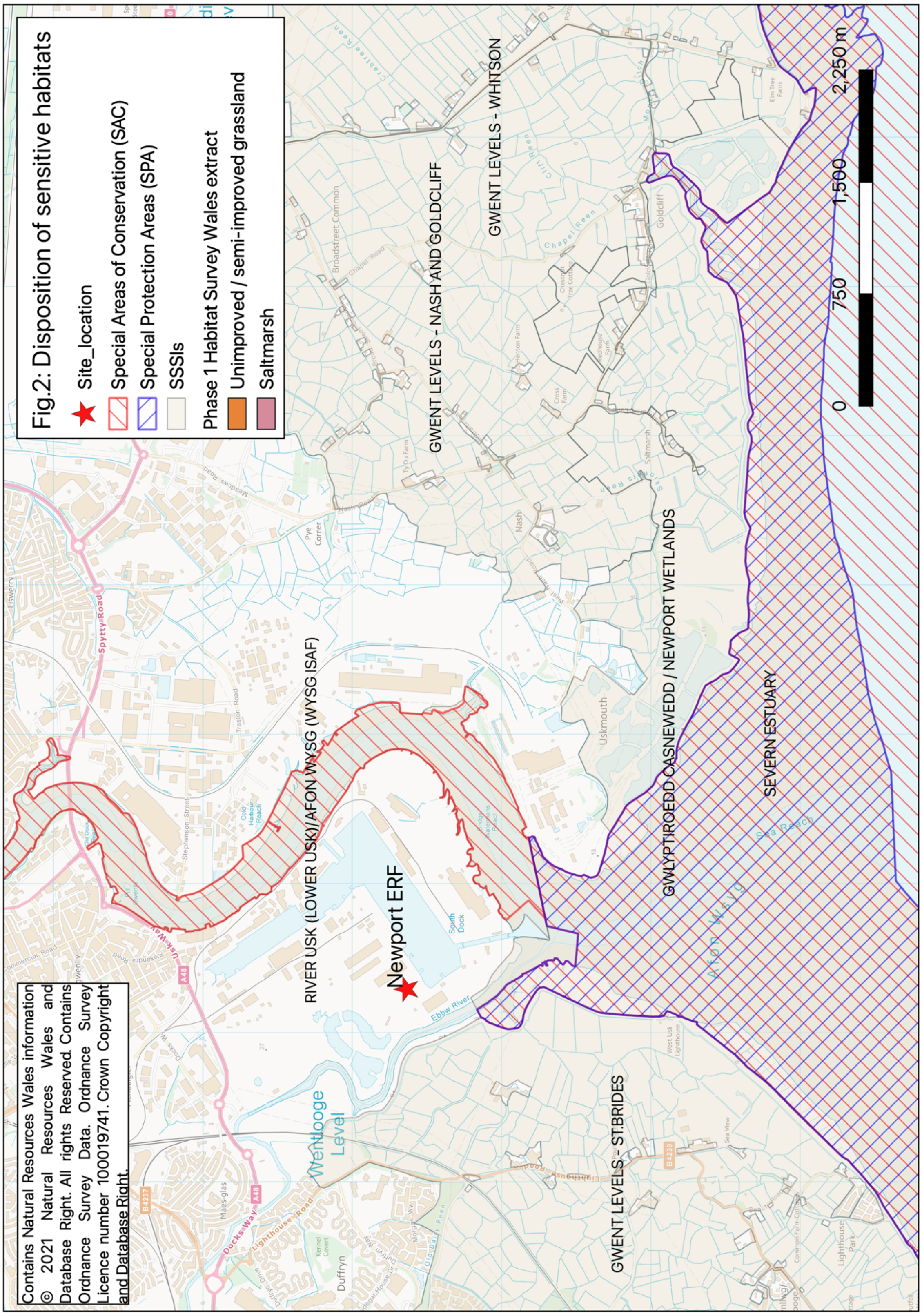

Fig.3: Phase 1 Habitat Map of Usk catchment